

AVIATION

The Oldest American Aeronautical Magazine

McGraw-Hill Publishing Company, Inc.

Price 50c. per copy

In this Issue
**HOW PLANE MAKERS
COOPERATE FOR VICTORY**

NOV.
1942



Safe Passage

At Midway, the Solomons, the Coral Sea, in Egypt and in Axis industrial areas the enemy has heard the sinister roar of Pratt & Whitney engines.

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AVIATION

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NOVEMBER, 1947

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Where every POUND of fuel counts...

Over increasingly greater distances each succeeding day, rugged American bombers fly in spite of rough weather and adverse winds, objectives must be reached. From every pound of fuel the pilot must extract every ounce of power. Hence the use in long range work of the "PROFEE" Fuel Flow Meter. This high-precision instrument tells the pilot at all times the exact rates at which his engine consumes fuel - enables him to adjust each engine control for maximum operating efficiency.

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PIONEER INSTRUMENT DIVISION

FOLLOWING up the several articles in the October issue giving the birds about our surprise-aircraft which have been quoted by press and radio sources taken from coast to coast—Anatomical the month presents an authoritative analysis of the factors controlling aircraft design and cockpit performance (page 56). This study by Maj. Nathaniel F. Scholer of the Army Air Forces—insiders' knowledge, pitfalls, some errors and design features and presents a close relation of work of the unfounded criticism which has been leveled at American aircraft. Every military plane is a compromise, but Maj. Scholer shows how American designers have done an outstanding job of compensating on the right factors. This report is both sound and concise.

Cooperating for Victory

Some of the reasons behind the success these production job done by the aircraft industry are presented for the first time in an exclusive ANATOMY survey (page 84) of cooperative features which today are the rule rather than the exception. This study shows how routine cooperation are not only leading each other vitally needed materials, but how they are leading available "know-how" leading each other resources and techniques—even stress device and production assets to assignments to keep the production line rolling at a faster pace.

In presenting Design Considerations for Personal Survival (page 314) ANATOMY begins an authoritative survey by L. J. Moultrie, an outstanding plastic bonded pressed glass engineer. His approach to the problem is very properly both, he treats plastic bonded glass design as it should be treated—a different technique rather than a mere adaptation of metal working practices.

Glider Connection

One of the greatest problems in developing America's glider program was to build the necessary military without raising the civil aviation supply of the industry. Just how it is being done, and how quickly is being maintained with quantity, is told in the article on Wood Technicians Developed in Glider Construction, beginning on page 358.

In the concluding article of the series on the Factors of Water-Based Plains (page 150) Capt. Fred T. Courtney shows why a new approach

to the problem of designing such craft is essential to give best performance comparable to land-based planes. It is inevitable, he points out, that water-based planes will equal land-based planes in performance, it is essential that such results be achieved first in this country if we are to maintain our qualitative superiority in aircraft development.

Drop Hammer Operations

New techniques which extend the scope of usefulness of drop hammers are presented in ANATOMY's readers (page 138) to the J. E. Ryan of the Army's 4th Engineer Group and Stephen S. Knight of the United States Army's 1st Engineer Group.

ANATOMY's month magazine's new regular feature in Picture Magazine (page 138), opening with a pointed, down-to-earth study on the maintenance of air writers in J. P.

Weyer. The equipment maintenance section this month focuses on the experience of piston rings (page 201), as which Paul S. Lane gives facts and advice of problems leading to better engine performance.

In the military field, Miles V. Case, ANATOMY's British correspondent, presents a detailed description of design features of Germany's Bf 109-400 engine, the most advanced aircraft engine yet produced (page 141). Case and the foreman of the Bf 109, the Bf 109 which is just beginning to make its appearance.

See Fewer of Nazi Plans

Also in the sphere of foreign aviation aircraft, ANATOMY reveals the power details of German planes. This exclusive "insider's" report in May Britain's article illustrates the possible future of the Luftwaffe's "military" and exposes their vulnerable spots.

In Guide P. V. H. Wren, understanding authority on equipment, explains the advantages of new simplified computers (page 255) for both military and civilian applications, illustrating these not by actual problems.

Coming

More than ever before, ANATOMY's Annual December Magazine December month will bring a wealth of new and useful information on maintenance practices and procedures in ANATOMY's military and civil operators of aircraft.

Maintenance of American Aircraft, Aircraft, Maintenance Problems in Maintenance, Maintenance Maintenance for Safety and Military Pilot Maintenance are but a few of the subjects which will be covered in increased authorities in this field.

The editors of ANATOMY are confident the maintenance from military depots, shops and factories over the length and breadth of the country in report first hand by the industry on the second and best provided information for better and faster maintenance. Numerous sketches, drawings and photographs will be provided, illustrating "effort" with new and better, better and shop equipment work as jobs, defects, work and special jobs and factors for repair—answers and other aircraft components.

Also, with the announcement of the winners of ANATOMY's coveted Annual Maintenance Award.



George F. Bower, author of "Air Corps Will Expand World Trade" (page 212) was for 12 years expert manager of the Automobile Manufacturers Association and as such directed campaigns in 44 countries. He initiated the World Trade League, and the work is supported by Jack Franklin Roosevelt and Secretary of State Hull. He concludes travels. He has had many opportunities to follow closely the developments in air transportation throughout the world, having been in Europe and South America as far back as 1924 and in Africa as early as 1929.



Their roots are sprouting SYNTHETIC RUBBER 10,000 miles away

Thousands of rubber trees have been destroyed in the Far East and millions more are being cut down. But the rubber game and the huge new synthetic rubber industry are growing up in America. These new roots will supply the world's needs for rubber. They will supply the world's needs for rubber. They will supply the world's needs for rubber.



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AVIATION, November, 1942

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PIPER



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♦ ♦ ♦ The best place to find this help is in the present war production industry. For instance, we at Spriesch are supplying the war effort with aircraft armament, Cannon Parts, Bomb Release Shackles, Automatic Bomb Release Hooks and

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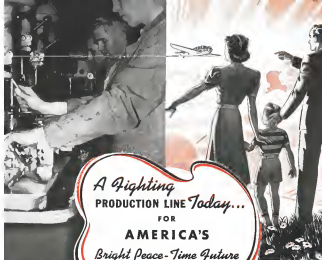
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Tool & Manufacturing Co., Inc.

10 Howard Street

Buffalo, New York

AVIATION November, 1942



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BUT TOUGH

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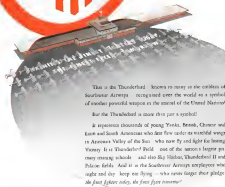
Fig. 959 "Hallowell"
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FOR PERSONAL FUNTS PLEASE LIGHT UP A CANDLE.
HE MISTOOK THE FLAP FOR THE LANDING GEAR HANDLE;
HE OVERSLEPT, UPON WHICH HE THOUGHT WAS THE GUN,
BUT FOLDED HIS FLAPS AND FELL IN ON HIS EAR.

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More Power to 'Em!



Translating the high speed revolutions of a motor into the slow driving power of an automobile means a slowdown in speed—an increase in power.

Footo Bros. speed reducers have the rugged construction, the simplicity, the high efficiency and unobscured operation that have won their acceptance by the Navy on our new battleships.

The lessons learned in the laboratory of war—the refinements made necessary in reduced size, reduced weight, increased efficiency and dependability, all spell new and improved speed reducers for industrial applications such as conveyors, elevators, agitators, mixers, dryers, mills, rollers and mills when the war is over.

The plant of Footo Bros. Gear and Machine Corporation is today a huge laboratory developing new techniques in engineering and new techniques in producing better gears and better speed reducers. These developments promise peacetime gains and speed reducers that will enable American manufacturers to provide better machines at lower cost.

FOOTE BROS. GEAR AND MACHINE CORPORATION
5501 North Western Boulevard
CHICAGO

FOOTE BROS.

Better Power Transmission Through Better Gears

Production is controlled by PIECES OF PAPER

SIMPLIFIED PAPER WORK ROUTINES SPEED AND INCREASE OUTPUT

★ Today thousands of shops and plants are engaged in unfamiliar work or are converting to war time production. In each, **TIME** is the most critical material. **COSTS** are a serious problem.

The production of men and machines and the accuracy of costs depend on paper work routines. The efficiency of these routines goes far in determining the speed of

production, the quality of finished work and the protection of costs.

Because Addressograph-Multigraph methods simplify and organize the paper work of production and allied activities, and because they save time, prevent mistakes and eliminate many costly wastes, they are now used by more concerns and in more ways than ever before.


USERS OF OUR PRODUCTS are entitled to the services of our Methods Department. It can help to extend the use of their equipment in Purchasing, Stocking, Production, Marketing, Shipping, Billing, Collecting, Discounting and all key operations of business. To those who are interested in up-to-date information on better methods it is available on request, without charge.

ADDRESSOGRAPH-MULTIGRAPH CORPORATION • Cleveland, Ohio
Addressograph and Multigraph are trade marks registered under United States Patent Office.

Addressograph-Multigraph Methods SAVE BRAIN HOURS AND HAND HOURS

Flying Men, Jeeps at Miles per Hour



-and each "Scintilla"
Aircraft Magneto
delivering  timed
sparks per second

Military units are the speed and carrying capacity of the new C-47 transport. You're sure to know that this transport airplane can land a unit of troops and its own fuel tank complete with its own fuel tank and engine, and you'll know that it can.

Carrying a cargo of this size and importance places extra stress on the dependable system furnished in the engine of these transports by "BENDIX-SCINTILLA" Aircraft Magneto. Like "BENDIX-SCINTILLA" Spark Plugs, Switches and other standard Ignition Hardware, the Magneto that delivers controlled lightning in all kinds of weather is built in a variety of types to give the best service to the world's best military transport and private plane.

"BENDIX-SCINTILLA" Aircraft Magneto, Switches, Spark Plugs and Ignition Hardware are important members of "The Scintilla Crew" which includes the complete equipment and accessories built by 12 Bendix Divisions, and working with our lighting crews on every hour.



BENDIX
SCINTILLA

THE WORLD'S FINEST AIRCRAFT IGNITION

TUBING AND PIPE PROTECTION METHODS

*Send today
for your copy*

A new catalog has been issued and lists the valuable Dr. van, discussed booklet, Tubing and Pipe Protection Methods to your information concerning this on product, non-chemical.



TUBING SEAL-CAP, INC. • 315 WEST SEVENTH ST., LOS ANGELES
Sole Representatives • 428 New Center Bldg • Detroit

3 Vital Facts

The Most EFFECTIVE Method p. 1

What a Seal-Plug WILL Do p. 2

What a Seal-Cap WILL Do p. 3

What a Plug-Cap WILL Do p. 4

What a Seal-Plug WILL Do p. 5

Shipping Methods for Sale p. 6

How Tubing Seal-Plugs are Used p. 7

Why Seal Tubing Seal-Plugs p. 8

TUBING SEAL-CAP, INC.

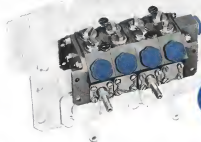
215 WEST SEVENTH STREET • LOS ANGELES, CALIFORNIA

On *all fronts* are **BOMBER PILOTS**
trained..



With
JACOBS *AIRCRAFT*
Engines

JACOBS AIRCRAFT ENGINE CO.
POTTSTOWN • PENNSYLVANIA • U.S.A.



OVER
70%
SMALLER,
LIGHTER

Smaller Space – BIGGER PROBLEM

Aircraft and industrial engineers faced with the problem of installing buffer controls in limited space will welcome the new ADL Single Unit Mighty Midget 4-Way Hydraulic Selector Valve which revolutionized previous concepts by offering space savings of 72% and weight savings of 78%, with performance characteristics actually superior to predecessor models. Single Unit Midgets permit the installation of several small size, high capacity valves in a closely confined area. Quadrigate Unit (dismounted measures only 5 1/2" x 3 7/8" x 2 1/2" with flanges and studs, weight only 2.9 lb).

Any number may be clamped together by means of "dow" pins and end plates which also serve in mounting brackets. All units are interchangeable. Symmetrical design permits turning end for end to secure desired shaft arrangement. Individual valve assemblies may be replaced by breaking only the two cylinder lines affected. Over travel is prevented by an

integral stop located on the camshaft. Normal servicing may be done by relatively unskilled persons without special tools.

In compliance with ADL policy, individual working parts in the entire Midget Group are manufactured to permit interchangeability between models and operating parts, economy in parts stocks and maximum service facility. Bodies fabricated from dual bar stock to assure uniform strength, freedom from porosity, maximum dependability with minimum size and weight. Valves and camshaft assemblies manufactured from stainless steel, heat treated to assure long service life. Critical dimensions obtained by grinding, micro finishing and polishing on specially designed ADL equipment.

Contact nearest Engineering Service office for complete performance data and immediate recommendations. Following regulations govern submission of complete information only to individuals affiliated with recognized armament industries.

ADL
PRECISION PRODUCTS CORP.
BURBANK, CALIFORNIA

ENGINEERING SERVICE OFFICE: Administration Bldg., Lee Road, BOSTON, MASS. • Air Transport Bldg., 1000 Washington Avenue, HUNTSVILLE, MISS. • 300 Franklin Bldg., HAMPSHIRE, MASS. • 300 E. Broad Street, TORONTO, ONTARIO, CANADA.

AVIATION November 1942

Millions of UNITED STATES GOVERNMENT dollars have *already* been saved with Southern Metal Forming Machines



In the busy leading aircraft plants where Southern No. 10 Metal Forming Machines are in daily operation, huge sums of money have already been saved the government—once less floor space and fewer skilled men have been required for tremendously increased production schedules. NOW the Southern No. 12 Attachment, which is used on the Southern No. 10 Metal Forming Machine, further increases the opportunity to machine-form extrusions... thus releasing much equipment for other important work.

NOW
more millions will be saved with the

SOUTHERN No. 12 Die-Flow METAL FORMER ATTACHMENT

by forming extrusions,
rolled and formed shapes,
with changes in
both planes and radii
at the same time

At left—Crossed view of No. 12 Machine with No. 12 Attachment installed in place of its ground bed—usually carries the No. 10 Machine. Cross shows typical open end being Die-Flow formed.

Of vital importance is the ability of the No. 12 Attachment to simultaneously form parts with varying radii and varying planes—each only one work set-up and one travel of the extrusion through the machine. Entirely new concepts in the speed with which extrusions and shapes can be formed, and the amount of machine forming that is possible with complex extrusions, are established by the Southern No. 12 Die-Flow Metal Former Attachment.

No. 2's, 3's, channels and angles of steel are being formed with the Southern No. 10 and the No. 12 Attachment—a feature of the one machine argued for forming extrusions. Major saving from this equipment has also been highly successful, but requires special engineering. Shown below is a large die stock open end formed with the No. 12 Attachment, showing an air trap. The open end is 1/2" thick, 12" wide at its widest point and 17 1/2" long, of 21 1/2" length. Each end produced in an exact duplicate of the other which can only be accomplished on the Southern Die-Flow Metal Former Attachment.



Change
PLANE & RADIUS
as many times
as wanted

SIMPLE TO OPERATE

The Southern No. 12 Die-Flow Metal Former attachment is a self-contained unit that is used on the Southern No. 10 Metal Forming Machine. Two controls vary the speed of the travel and the amount of pressure exerted on the metal. One operator and a helper can do the work of scores of men otherwise required to hand form the parts.

DIES QUICKLY CHANGED

Installation of dies and former blocks requires an special skill—is quickly done... as that short run of special parts are just as practical as long runs of production parts. In some aircraft plants Southern Machines operate 24-hours per day on new extrusion designs—in other places the dies may be changed every few hours.

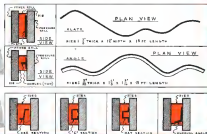
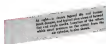
RUGGEDLY BUILT

All Southern Machines are ruggedly built to withstand continuous operation under severe production conditions. Frames are welded steel, air cylinders, hydraulic accessories, electric meters and variable speed gear drives are designed especially for their particular functions. Maintenance and servicing requirements have been held to a minimum, with easily accessible grease and lubrication points.

EXTREMELY FLEXIBLE

Whether it is a part requiring as small as a 1/8" radius on a single change in radius, or a part that requires reverse curves in series—whether the part is only a few inches long, or 30 feet in length—whether there is no change in plane, or a dozen changes... the Southern No. 12 attachment does the work with equal speed and efficiency.

We offer the services of
engineering, die and
tool manufacturing—for
use on Southern Machines.



SOUTHERN ENGINEERING CO., INC.

816 West 5th Street

Los Angeles, California

only **one** • • *"fits" your Factory*



Westinghouse



CHOOSE THE POWER DISTRIBUTION SYSTEM THAT MEETS ALL OF YOUR REQUIREMENTS

It's easy to select the right plant distribution system. There are many different types available from which to make your selection. The important job is to choose the system that meets your plant's individual requirements. Only then can you be sure of maximum profits, both from the standpoint of economy and efficiency.

Investigate carefully before you install. Regardless of the size, shape or type of factory you'll find an established distribution system that will service your load requirements.

Westinghouse can supply equipment for all of the different systems, including the new Plant Network System which has been adopted by nearly 40 new, large war factories.

All systems recommended by Westinghouse are designed for use with standard distribution equipment. No matter which system you select there will be no need to build special apparatus.

To help you select the system that fits your plant, Westinghouse has prepared a special book in which the advantages and applications of a group of different systems are briefly described. Just fill in and mail the coupon for your copy.

If you want faster action, phone our nearest office and ask one of our engineers to call and discuss your distribution problem. You will get immediate cooperation.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.



FREE SEND FACTS ABOUT PLANT DISTRIBUTION SYSTEMS

Westinghouse Electric & Mfg. Co.,
East Pittsburgh, Pa.
Please send book **FACTS** along with facts on
Westinghouse Distribution Systems.

Name Title
Company
Address
City State ZIP

PLANT DISTRIBUTION SYSTEMS



23 YEARS AGO
Firestone
PIONEERED
"SHIP BY TRUCK"

Today Firestone

ACROSS the wide expanse of the seven seas soar the vanguards of a new and growing fleet of planes that are as vital to Victory as bombers and fighters. Soon thousands of cargo-carrying planes will be poised on the brink of Europe, Asia, Africa and Australia, ready to carry paratroops and air-borne infantry to a vertical counter-invasion. And after they have discharged their loads of fighting men they will return

again and again with tanks and jeeps, guns and supplies to keep those men fighting.

Flying on wings built by Firestone, these huge air freighters are the forerunners of a new and swifter system of peace-time transportation that will reach even to the most remote corners of the world. But building parts for these flying freighters is only one of the many ways by which Firestone is pioneering the "Ship by Air"



PIONEERS "SHIP BY AIR"

movement. Bombs and bullets are also being "Shipped by Air" and delivered with devastating effect upon our enemies by planes equipped with many Firestone products.

Yes, Firestone is all-out for Victory! And from the caustic flames of war will emerge a swifter method of distributing the world's goods. In the not too distant future, air freight can well become as commonplace

as air mail, air express and air travel. And Firestone, always a leader in all forms of transportation, will be an important factor in "Ship by Air."



Firestone was the first Company in the rubber industry to win the coveted Army-Navy Production Award for high achievement in the production of war materials.

Shown in the Photo of Victory with Richard Cordell, Secretary of War and the President Franklin D. Roosevelt, under the direction of Alfred Wallinga, Director General, U. S. E. C.

FIRESTONE MANUFACTURES A WIDE RANGE OF MATERIALS FOR THE AIRCRAFT INDUSTRY





Scratch One Flat Top

U. S. Submarines glide through the dark water. They range the enemy's seas, looking for one thing—a clear sight—the first sight at an Axis ship. Then, striking alone, or with the battleforce, or airforce, as at Midway, they fire their deadly missiles.

At VARD we are helping our Navy get that first, accurate sight on the enemy ship.

We are working around the clock, making navigation instruments, aircraft parts and optical goods. VARD precision inspection gages are also produced for many plants manufacturing ordnance.

Our entire strength is devoted to the war effort. "We are working longer hours. We . . . realize that one extra plane or extra tank or extra gun or extra ship completed tomorrow may, in a few months, turn the tide on some distant battlefield; it may make the difference between life and death for some of our fighting men." **

VARD INC.
PASADENA, CALIFORNIA, U. S. A.

* REPORT TO CABINET, BY SQUADRON LEADER, LT. COM. ROBERT DIXON, ON U. S. NAVAL ACTION, CORAL SEA, MAY 7, 1942.

** FROM RADIO ADDRESS, BY PRESIDENT ROOSEVELT, AT WHITE HOUSE, FEBRUARY 23, 1942.



Transport Protection

a vast amount of correct information regarding application data, timing rates, drying schedules, etc., on Government finishes as adapted by all branches of our Armed Forces. Here are just three excellent reasons why—

1. We are supplying U. S. Government specifications finishes to makers of a wide variety of war weapons and material.
2. Our research and field technicians have been continuously co-operating in the development of finishes for modern means of war.

3. We've had years of experience in developing special formulations for a great variety of well-known industrial products.

The point is, we know industrial finishing problems and we know Government Specification Finishes. Furthermore, we know that your inquiries for bids or other data must have prompt attention. And you'll get it here.



INDUSTRIAL SALES
THE LOWE BROTHERS CO.,
DAYTON, OHIO.

Lowe Brothers WARTIME FINISHES for Industry

IN ACCORDANCE WITH U. S. GOVERNMENT SPECIFICATIONS



AND MAINTENANCE PAINTS
TO MAINTAIN YOUR MAXIMUM EFFICIENCY

It's healthier on the Attacking Side

Whether you're fighting a bug 5 miles up or tackling a problem in the shop... it helps a lot to have the jump on your competitor.

ALTER EGG: True as gospel. Competition forces progress. We've diverged over to welding of ships, planes, tanks and guns. Why? Because the Axis had a head start in design and output. They forced us to make 'em better and build 'em faster.

Imagine that! It took a threat to us

very long to drive home the necessity of converting old methods to new!

ALTER EGG: But have we learned our lesson? Will we be content to plod along after the scrap is over? As for me, I'm going to convert now to the offensive for tomorrow's battle for business.

That's the spirit! Let's take off our rose-colored glasses and put on our reading glasses. Let's learn all about welding so we can get the jump on competition.

THE LINCOLN ELECTRIC COMPANY
CLEVELAND, OHIO

ALTER EGG: Luckily, our alter ego is the one who makes the conversion. Right? (unintentional) (unintentional) (unintentional)

Photo Courtesy: Lockheed Aircraft Corp.



Any war plant can have this free advisory service



LIGHTING badspots, often unsuspected by plant managers, may seriously impede war production—especially on night shifts. Glare in the eyes of workers, shadows on work, dirt and grease on lamps and fixtures, improper placing of fixtures, can slow up production and increase spoilage. Inexpensive changes in lighting often make a decided difference.

As a part of its contribution to the war effort, General Electric is glad to offer the services of its staff of trained lighting men—without charge—to any war factory, large or small.

THERE ARE NO STRINGS TO THIS OFFER—no obligation to buy so much as a bulb. The G-E lighting man's first job is to try to

make better use of present lighting equipment. He checks to see if lamps are proper size. Occasionally he finds a spot where a supplementary light will help with some critical job. And he only recommends a new lighting installation where it is absolutely essential to production.

TO TAKE IMMEDIATE ADVANTAGE of this free service, all you need to do is this: Call your local General Electric lamp office, or your G-E lamp supplier, or write General Electric Company, Nela Park, Cleveland, Ohio. Your local power company is also ready to give you this same kind of help.

If light can work harder in your plant, now is the time to find out about it!

G-E MAZDA LAMPS
GENERAL ELECTRIC

DISCOVER THE NEW
...and a HELLDIVER it is!
...and a HELLDIVER it is!
...and a HELLDIVER it is!



When, in 1929, Curtiss-Wright built the first carrier-based Navy airplane designed specifically for deck-boarding, its then sensational ability inspired the name, "HellDiver". Today's HellDiver, the new SB2C-1,

more than ever justifies its name... for its flying speed and the precise destructive power of its heavier bomb load and deadly armament have won the rating of "world's best" in the judgment of impartial authorities.

CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION



1909 - First Curtiss-Wright Navy Airplane built specifically for deck-boarding and carrier recovery. It was the origin of our standard and a fine machine that completed the mission.



1920 - A further step was made in higher deck-boarding and carrier recovery. The Curtiss-Wright Navy Airplane was built to look the United States Navy and Marine.



1927 - After modification of design, the Curtiss-Wright Navy Airplane built a truly heavy-duty carrier recovery, and completely re-designed based on new Navy service in the United States Navy.



1929 - The Hellcat was presented with a World War II award for the carrier war and equipped on deck-boarding. Plans of this model were still being delivered in the Navy in 1940.





Forward Wings to Army Air Cadets

YOUR SON MAY BE our Boss

Somewhere high above a frenzied field of battle is the dynamic roar of guns and cannons. Like miniature models, in a distant sky, a squadron of Army P-39 Airacobras, powerful pilots by American Youth leaders it out against the enemy.

These are the battles for which we build. Battles that are our inspiration to make every Airacobra we build one of the world's most deadly single-engine fighters. We keenly feel the responsibility that rests upon us. The success of our Army Air Force Pilots and every man in our fighting services depends upon mastery of the air. We at Bell Aircraft are serving these men with every ounce of

ingenuity and skill at our command. They are extended to our greatest efforts. They are the men for whom we work.

Among the millions of boys now serving in the fighting forces of our country you may have a son. It is our duty to serve and protect him. We are doing it by providing the mightiest weapons we know how to build. We are proud to have him as our boss. And we shall be

prepared to keep him as our boss. For tomorrow, when victory is won, these men and boys now in service will return to their places in industry and commerce. We look forward to serving them with the planes of peace in a new world of advanced aviation. © Bell Aircraft Corporation, Buffalo, New York.

Airacobras for victory—
BELL *Aircraft*
FUTURE PLANS FOR PEACE

PEACEMAKER OF AVIATION PROGRESS



"For High Achievement in the Production of War Materials!"

WE of Aluminum Industries, Inc., are proud of the new flag that floats over our four plants — proud because it is the Army-Navy "E" awarded "for high achievement in the production of war materials."

No one man is responsible for winning this much coveted award. Rather it is due to the loyalty and cooperation of every worker who, in his desire to furnish the tools for victory, has unflinchingly given to his job, the best that is in him.

But the job is not finished. Even greater efforts are called for — and will be gladly given. We are determined to keep the "E" flag flying until complete victory is won.



ALUMINUM INDUSTRIES, Inc., Cincinnati, Ohio

Detroit: 305 New Center Bldg

Los Angeles: 124 N. San Pedro St.

Chicago: 414 S. Michigan Ave.

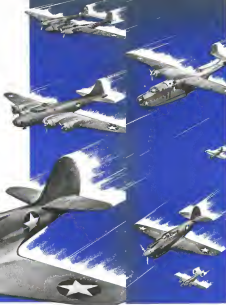
PERMITE ALUMINUM AND MAGNESIUM ALLOY CASTINGS

AVIATION, November, 1942

Salute TO THE JOB THEY'RE DOING!

NO SINGLE PART of an airplane can claim all credit for protecting a pilot's life. The ship is a roaring, pulsing structure of thousands of parts, each painstakingly engineered, each unerringly precision-built, each doing its part to protect the lives of the boys it carries, and smile hard for Victory.

That's why it takes so long to engineer an airplane, and get it into production. And that's also why one United States, with its willingness to break with tradition, its engineering skill, its vast plant and attached mass-production integrity, each developed individually and now brought together in a colossal whole, is outbuilding the enemy in air power.



Names the U. S.
must never forget



BEECH
BELL
BOEING
BREWSTER
COLGATE
CONSOLIDATED
CURTISS-WRIGHT
DOUGLAS
FAIRCHILD
FLEETWING
FORD
G & A AIRCRAFT
GENERAL MOTORS
GOODYEAR
GRUMMAN
HOWARD
LOCKHEED
MARTIN
McDONNELL
NORTH AMERICAN
NORTHROP
REPUBLIC
TAYLOR CRAFT
TIMM
VEGA
VOUGHT-SIKORSKY
VULFEE
WACO

LIFELINE?

We'd like to say that the Roebling Control Cord that carries the pilot's slightest touch to elevator or rudder or ailerons is the ship's life line. We can't claim that much credit. But we can—and do—think that way, as we build into it steady strength and toughness, silky flexibility. All the care and skill we've got goes into every inch of it.

JOHN A. ROEBLING'S SONS COMPANY
BRANTON, NEW JERSEY - Branches and Warehouses in Principal Cities

THE ROEBLING DEVELOPMENT LABORATORIES



... Dedicated to Victory. Bring your problem to **Tension!** Here you will find one of the finest wire rope research and development laboratories in the world. Its regular routines include fatigue tests on control cords, dissection and studies of steel cords, metallurgical research. Perhaps you want to check stretch characteristics ... temperature changes and their effects ... results of changes in pulley sizes. Roebling engineers, with a background of a hundred years' knowledge of wire rope, will be glad to place these facilities at your service and co-operate with you to the hilt.

How to get the MOST out of Control Cord

Third of a series of messages to familiarize you with the basic principles of installation, inspection and care

POINT No. 3—
**INSPECT
WITH
CARE!**



HARD TEST



LOOK FOR FLAT SPOTS

For safety a complete visual examination every 1000 hours between shifts. Many times on first post flight one wire pulley also required



TO REPLACE CABLES,



Stretch a length of safety wire on all main cables removing from the ship. As the old cable is pulled out, the wire will take its place and the new cable can then be pulled through by attaching it to the safety wire

ROEBLING means

Control in the Air!

EDO FLOAT GEAR

STANDARD THE WORLD OVER



Edo-equipped seaplanes of the U. S. Coast Guard
patrolling a convoy

★ ★ ★ ★ ★ EDO manufactures single and twin Float Gear for the aircraft of the U. S. Navy, U. S. Army Air Forces and leading Foreign Governments. Edo Aircraft Corporation, 462 Second St., College Point, N.Y., U.S.A.

AVIATION, November, 1940

...dish it out!

In the class... and from the class... your warplanes dish it out, America! Your fighters... and your bombers... now every day there they shoot. They're blasting on the offensive... not along a schedule to Axis schedule.

But at home, America... you're got to dish it out, too. In this fight, the pay off is far during it out on all forms of food war... everywhere.

America's planes have pushed... and your flying forces are getting them in quickly. Backed up by a united, fighting America, they're a combination that can make invincible the air mastery of the United Nations.

For this mastery, Lockheed holds the P-38 Lightning, the world's fastest two-engine fighter... officially... and the Lockheed Hudson bomber. Lockheed Aircraft Corporation... Vega Aircraft Corporation... Burbank, California.

For protection today, and progress tomorrow, look to

Lockheed

FOR LEADERSHIP



AVIATION, November, 1940

FAST EXPRESS TO *all* FIGHTING FRONTS!



Photo from Curtiss-Wright Corporation

Fast-dying, big-capacity planes are getting ready to take over the important job of keeping the battlefronts supplied with fresh troops and fighting equipment. They're built to go anywhere. They're giants in the air, but feater and trickier than you would imagine. Fighters on the controls—at all vital points of action—play a big part in securing essential maneuverability and controllability.

"Fafnir" appeared on the blueprints of one of these giant planes—just as it has appeared in the planning stage of other American-built warplanes. "Fafnir on the controls" has been a standard specification throughout the aircraft industry since the days of the "horned dragons"—you'll find them today on many fighting and transport aircraft. The Fafnir Bearing Company, New Britain, Conn.



Need the expert advice of our service department? You will find it in booklet service guide.

We make lungs



FOR ONE-MAN RAFTS



There's a new story coming out of the Pacific war theater. We are beginning to read of men and men again. It is a good story, because it's about men's lives being saved—lives which would have been lost in World War No. 1.

World Down told the story first. He and his brother were stranded for 34 days on a 4' x 4' submersible carbon-dioxide-inflated raft. Then Eugene Gay added his version. He charged to the Kidde raft and got a "big-eye view" of the Midway sea battle. Now we hear of American Matthew Winshall who drifted for 18 days, sharing his raft with his newborn.

There men was their lives in sophisticated fabric and in carbon dioxide gas. We hear of the gas port. Walter Kidde is Company makes the carbon dioxide cylinders and

valves which turn a handle of fabric into a "baptist" life raft.

Now the trend points to men man-eating for men raft in a parachute-type pack. A Kidde bottle, holding 7½ ft. of carbon dioxide, inflates the raft. We make the cylinder shock-proof so it won't fragment, if a bullet hits it.

Then carbon dioxide tackles another war equipment. When you check all the jobs it is doing, carbon dioxide is certainly the hardest working gas that man knows and uses. High pressure gases are not special field. Kidde engineers stand strong behind U. S. experts in storage, release, saving of gases under pressure.

If any aspect of high pressure gases presents a problem to your technical staff, we hope you'll call us in.

Research and Development Department of

Kidde 

Walter Kidde & Company, Inc., 1122 West Street, Bloomfield, N. J.

AVIATION November, 1942

"Gramp" YAEGER'S BACK ON THE JOB!

"Gramp" Yeager's typical of the thousands of skilled old-timers in industry able to continue doing precision work . . . If you give them the kind of man-made daylight provided by MILLER Continuous-Wireway Fluorescent Lighting System . . .



WFE says, "When old-timers are provided with good lighting, injured in their work, it is frequently possible for them to keep on doing the precision work for which they are fitted."

MILLER 50 FOOT CANDLE or 100 FOOT CANDLE will provide your plant with fine man-made daylight . . . adequate, productive illumination evenly distributed over every working surface. MILLER fixtures will duplicate that performance in your plant offices and drafting room.

Better lighting will actually make your workers see better, feel better, work better. It will help speed production, cut

down scrapage, improve worker morale, reduce accidents and give you a completely new working place. It is constructed to first savings in critical modern shops . . . in production time and dollars . . . and in power consumption.

Just under 200 years of lighting experience . . . working with incandescents, fluorescent and mercury vapor . . . has enabled MILLER to offer through its own service a lighting "experience" which is at your command . . . to provide the best type of lighting system for your business. If you so wish, we'll get on the job at once.

MILLER

50 FOOT CANDLE
100 FOOT CANDLE
MILLER TRAFFIC
Continuous-Wireway Fluorescent
Lighting System

THE MILLER COMPANY
MERRICK, KANS.

Proven lighting line that
MILLER offers a complete line of
traffic and industrial lighting equipment.

A MILLER Yeager inspired by WFE's helpful booklet, "Plant Efficiency."



**15 YEARS
OF SUCCESSFUL OPERATION,
with . . . "Efficiency of
maintenance . . . largely
assisted by**

***Snap-on
Tools***

THROUGHOUT its long, successful history, Pennsylvania Central Airlines has adhered to highest standards of maintenance, and has won enviable recognition for its contributions to the safety of air transportation. And Pennsylvania Central joins every other major airline in endorsement of Snap-on Tools!

Says Captain J. H. Corns, vice-president in charge of maintenance and engineering: "The proved efficiency of Pennsylvania Central Airlines' maintenance operations is largely assisted by the use of Snap-on Tools . . . where working space is limited, where the proper fit of a wrench avoids injury to adjacent parts, or where the mechanic's safety depends on the strength or safe leverage of the tool he uses, Snap-on have been found to be extremely efficient. They are adaptable to all types of maintenance operations."

The 3,000 tools in the Snap-on line . . . and Snap-on's direct-to-you service . . . are conveniently near you through 55 factory branches



in key aviation centers throughout America. Send for catalog and full information.

Snap-on Tools

THE KNIFE OF BETTER MECHANICS

SNAP-ON TOOLS CORPORATION
8720 N. 29th AVENUE
KANE PA, WISCONSIN

FEDERAL

Aircraft

BEARINGS

EVERY FEDERAL AIRCRAFT BEARING IS CAREFULLY MANUFACTURED AND PERFECTLY FINISHED • PRECISION AND ACCURACY DOWN TO THE SMALLEST DETAIL. FEDERALS ARE TOUGH, STRONG, DURABLE —AN INVESTMENT IN BALL BEARING SERVICE AND SATISFACTION •



THE FEDERAL BEARINGS CO., INC.

Makers of Fine Ball Bearings

U.S.A.

INTERNATIONAL OFFICES AT

Detroit: 1545 Bank Tower • Cleveland: 4255 Seaview Building
Chicago: 885 S. Wabash Ave. • Los Angeles: 2410 Wilshire Blvd.

For Precision and Speed Use

SIoux

WET GRINDING AIRCRAFT TOOLS



SIoux Wet Valve Seat Grinding Machine For Aircraft Radial Motors

Wide Range — up to 6 1/2" shaft diameter. Produces wheel loading and stretching — assuring better finish and accuracy. Cylinder held securely in worktable which turns and rotates for wet grinding both exhaust and intake valve seats without removing cylinder. Coolant fed up from bottom between cutting wheel and valve seat, flushes away all grindings. Wheel dressing provided in a minimum. Compact and efficient. Everything within easy reach.

SIoux Valve Face Grinding Machine WET GRINDER . . .

For precision work in less time — for smoother, more finished jobs, this machine meets all the requirements of both production and maintenance plants. It grinds all valves, any angle, including 90° flat valves. Grinding load easily adjusted for large or small valves. It wet grinds valve tappets and rocker arms to original efficiency.

WRITE FOR FULL DETAILS



STANDARD THE
ALBERTSON & CO., INC.



WORLD OVER
SIOUX CITY, IOWA, U. S. A.



Triple-threat

One of the best ways to put the squeeze on the Air is to produce better air planes, faster.

This giant, triple action press—using hydraulic, pneumatic, and hydraulic pressure—is built for that job.

Built to the specifications of Boeing engineers, this press and a team at Boeing's Midwest plant are unique in the aircraft industry. They are machines that form steel, disassemble or assemble with equal ease.

The job of this press is to squeeze out engine parts, to make them evenly stiffer, and to make them fast.

Right now it is turning out flier's angles, landing surfaces, built-in channels and exhaust stacks for the Flying Fortress.*

It makes some of these parts 15 times faster than the machine it replaced.

This performance, one of the reasons why Boeing production is steadily increasing, why Boeing was selected as the first aircraft company to receive the Army-Navy award for high achievement in production (The rate of output of Flying Fortresses is now more than three times what it was on the day of Pearl Harbor.)

The pressure is on at Boeing for cost and weight. This heavy press, in its turn, is the most powerful of the Boeing presses, a symbol of efficiency, in air plane production. It is one of a team of presses, one of a team of thousands of machines, part of the unbeatable American system of combining men and machines to shape our ends.

The measure of efficiency, in manufacturing, for price and cost, is each one of the many different projects that form a constant part of the Boeing engineering schedule in Seattle and in the Middle West and Canada.

BOEING

DESIGNERS OF THE FLYING Fortress • THE STRATOLINER • FIVE AMERICAN CLIPPERS

*See TODAY, "AIRCRAFT FABRICATING," and "AIRCRAFT ENGINE AND AIRCRAFT ENGINE TESTS."

AVIATION, November, 1942

SYLPHON

AIRCRAFT CONTROLS



OIL COOLER THERMOSTATS

Approved by the U. S. Army Air Corps for controlling lubricating oil temperature in aircraft engines, and designated as the Type D-S.

Operates in automatically proportioning the amount of oil passed through the cooler or by-passed directly back to oil tank, to maintain constant oil temperature at predetermined degree.

Safety release mechanism automatically forces valve into safety position, preventing overheating of the oil in event of bellows failure.

The thermostat also acts as an ordinary pressure relief valve to protect oil cooler from damage by high pressure when inlet pressure exceeds a set value.

Another U. S. Army Corps Approved Oil Cooler Thermostat design noted as Type D-S in the same in all respects except that safety release mechanism is not included.

The extensive engineering and production facilities of this Company are freely offered to assist the Aircraft Industry in securing the dependable controls and other bellows devices it needs—promptly and in any quantities.



Possibly are the most exacting design and construction in the production of War Mechanisms.

SYLPHON PRODUCTS FOR THE AIRCRAFT INDUSTRY INCLUDE:

- Liquid Cooled Engine Thermostats
- Oil Cooler Thermostats
- Fuel Pressure Regulating Valves
- Rheostatic Motor Regimes
- Air-Flowing Vacuum Regulator for Engine Instruments
- Bellows Assemblies for Super-Charger Controls, Carburetor Controls, Fuel Injector Controls, etc.
- Short Stroke Inlet Manifold, Hydraulic Pumps, etc.

THE FULTON SYLPHON CO.
KNOXVILLE, TENNESSEE

Representatives in All Principal Cities in U. S. A. and in Montreal, Canada and London, England

VITAL PLANES *need these* VITAL PARTS



U. S. BULLET SEALING HOSE

For fuel lines. Vital safety feature.



U. S. SYNTHETIC RUBBER FUEL, OIL, & COOLANT HOSE

For sheet connections that break up destructive vibration on fuel, oil, and coolant lines.



U. S. FLAME RETARDANT GASOLINE HOSE

Protects against flame forward of firewall.



U. S. AIR DUCT HOSE

Extremely flexible, wire-supported hose used to conduct air at temperatures up to 350°F.



U. S. HYDRAULIC HOSE

Low, medium, and high pressure types for external flexible connections in hydraulic lines.



U. S. FLEXIBLE DUCT CONNECTORS

Flexible connections on super-charger systems that conduct air from scoop through various operating stages—absorb destructive vibration.



U. S. MULTI-FLEX TUBES

Extremely flexible and lightweight. Used in boost, control valve, bellows, gasoline tank air vents, and machine gun shell ejection chutes.



U. S. MULTI-FLEX AIR DUCTS

Flame-proof flexible connectors and ducts conserving critical materials.



U. S. ROYAL RUBBER MOUNTINGS

Promote accuracy and life of vital instruments by reducing the transmission of vibration, noise and shock.

Also special rubber-bonded-to-metal parts.



MISCELLANEOUS RUBBER PARTS

Bumpers
Bushings
Gaskets
Sleevers and Connectors
Flexible tubing

Also custom molded and extruded parts.



U. S. PEERLESS BATTERY SEPARATORS

Because of low electrical resistance, mechanical strength, and chemical durability, these superprecise hard rubber separators provide superior battery performance for aircraft.



U. S. WIRES, CABLES, AND TAPES

For aircraft lighting and ignition.



U. S. ROYAL HARD CELLULAR RUBBER

This featherweight board (4.5 lb. per cu. ft.) won't support combustion. Used for fuel tank and other supports.

U. S. PACKINGS Woven asbestos cloth, coated with synthetic rubber.

Rockar box cover gaskets — all resistant synthetic compound for temperatures up to 450°F.

UNVULCANIZED GUM For making permanent airtight closures.

U. S. CEMENTS A complete range of cements for adhering flexible materials to porous and non-porous surfaces.

For complete description, sizes and service data on these and other vital aircraft products, refer to this new book prepared especially for Aircraft Design Engineers.



UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION 1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK



SCRAP SALVAGE is a **LAW** at GREENFIELD...

SO ACUTE is America's metal shortage—particularly of high speed tool steel—that today the importance of scrap cannot be overemphasized.

Industry has a responsibility it cannot evade, not only to reduce scrap-making in plants, but to salvage it to the last ounce. Even the tungsten from filings and sludge must be recovered and turned back into productive channels.

The Greenfield Tap And Die Corporation has assured our Government that a rigid plan of salvaging is now in force in every department of its plants.

What "Greenfield" is doing, must be done by every factory and shop throughout the country. Failure to carry out a scrupulous system of salvaging can almost be viewed as actual sabotage!



GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASSACHUSETTS
BRANCH PLANTS: 620 Second Boulevard
Waltham in New York Chicago and Los Angeles
In Canada
Greenfield Tap and Die Corp. of Canada, Ltd. 1041 St.

AVIATION November 1942



TIME TO ATTACK!

and our fighting pilots deserve our best!



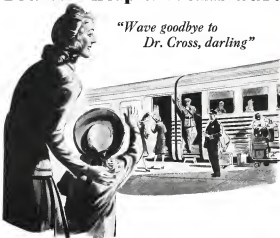
FOR FOREMOST PERFORMANCE:
Aircraft Hydraulics, Fuel Pumps,
Air Pumps, related accessories by...



Division of Borg-Warner
Cleveland, Ohio

Just by KEEPING WELL You can help win this war!

*"Wave goodbye to
Dr. Cross, darling"*



FOLLOW THESE 5 RULES

Remember these five keys to good health. Follow them carefully—for your own welfare and for victory.

1. Eat Right

Milk, butter, eggs, fish, meat, fruits, beans and peas, fruits, green leafy vegetables and the yellow ones, whole-grain or enriched cereals and bread—these are the key foods. Eat plenty of them—*at least* 5 meals a day!

2. Get Your Rest

Regularly exercise your body. You can't catch up on rest sleep on mind relaxation! Try to keep on a regular schedule every day. Take a nap for a while while your back and bones get to rest on a time, just up on it too.

3. See Your Doctor Once a Year

You have your car checked and serviced every thousand miles. Do as much for your body. Physicians can prevent many diseases and illnesses for both children and grownups now.

days. Get your doctor's advice now BEFORE you get sick. Go to see him!

4. Keep Clean

Plenty of baths, lots of soap. Clean hands! Clothes, linens, beds! Get fresh air, sunshine. Drink lots of water.

5. "Play" Some Each Day

Keep with the family, meet with friends, take walks, play games—or do whatever you like to give your mind and body a change from the daily grind on the job. All work and no play makes Jack a dull boy!

(Courtesy, Institute of Life Insurance)

THIS SPACE CONTRIBUTED BY THE BQ CORPORATION

AVIATION, November, 1942

FOR SAFER, SURER TAKE-OFFS AND LANDINGS



SCOTT STRUTS
AND TAIL TRIM
TAIL WHEEL ASSEMBLY

Piper Liaison Planes DEPEND ON SCOTT

Fulfilling their important mission with versatility and dispatch, Piper Liaison planes depend on Scott Tail Wheel Assemblies to "bring up the rear"—and set them down, too—with unflinching performance.

Engineered by Scott to simplify maintainability on the ground, these tail wheel assemblies meet the exacting requirements of strength plus lightness. In fact, they are the lightest units of this type ever developed!

Each Scott Tail Wheel Assembly is individually and meticulously stress-tested for shock resistance—the plane's assurance of reliable service under severest ground conditions.

Today—in many ways—Scott is contributing to the safety and effectiveness of our air forces. Scott assemblies and

special equipment include: Oxygen Handholds... Oxygen Regulators... Brake Pressure Units... Control Wheels... Brakeline Yokes... Builder Hoses... Airline Railroads and 40-C Scott-Cast Aluminum Alloy Castings.

Your inquiry on special equipment problems will receive prompt and confidential attention.

Scott
AVIATION CORPORATION
14000 WILSON AVENUE
TOLSON, CALIFORNIA

SUPPLIES TO THE U. S. ARMY AND NAVY AIR FORCE, AND LANDING, BUSHY, MARINE CORPS.

AVIATION, November, 1942

42

POWER + WEIGHT -



Reading AERO Batteries

Military requirements of today have emphasized the need of an Aviation Battery both light and powerful.

Years of experience in the Aviation field have enabled READING BATTERIES, INC., to produce a battery of minimum weight, yet "packed with power".

Acceptance by the Military Forces, has confirmed the judgment of the Commercial Trade — that the READING "AERO" BATTERY is the ideal light-weight, dependable battery for Aviation use.

When ready — Consult READING

CONTRACTORS TO THE U.S. GOVERNMENT AND TO THE PRINCIPAL AIRCRAFT MANUFACTURERS

READING BATTERIES, INC.
READING, PENNSYLVANIA - CABLE ADDRESS: "REBAT"



BETTER ENGINES THIS TIME ...

and better oil!

COMPARED to today's sleek warbirds, the flying chicken-coops of 1918 look like museum pieces. Motor oil, too, has come a long way since the days when 150 m.p.h. was the answer to an aviator's prayer.

Wolf's Head can point to a record of refining improvements that have consistently matched advances in aviation engineering. Today's Wolf's Head is better than the Wolf's Head of only a few months ago. Tomorrow's Wolf's Head will be better still, for we aim to make war-born lessons lead to major developments in the peace to come. Wolf's Head Oil Refining Co., Oil City, Pa. New York, N. Y.



WOLF'S HEAD

100% PENNSYLVANIA
Aviation MOTOR OIL

PAN AMERICAN "CLIPPERS,"

WINGED FOR VICTORY

Are Equipped with



NORMA-HOFFMANN

Day and night, over oceans and continents, passing only for meticulous maintenance, the "Clippers" of Pan American Airways System are carrying men, messages, materials and supplies swiftly and surely to the four quarters of the globe, in the service of the United Nations and in support of their fighting forces. Flying faster and more frequently than ever before, under War's exacting demands, these great planes are subjected to crucial tests unparalleled in peacetime. Yet they must—and do—"keep flying".

In these transports of Pan American and its affiliated companies—as in the fighting planes and bombers on every war front—NORMA-HOFFMANN PRECISION BEARINGS are proving their dependability "where the bearings MUST NOT fail". In the control mechanisms, instruments and other vital plane accessory equipment, they are insuring that trustworthy performance which enables Pan American to "keep 'em flying".

*Precision
bearings*



NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN. FOUNDED 1911

Write for the Catalog. Let our engineers work with you

Copies of this new catalog available to industry personnel, when requested on company letterhead.

HARVILL HYDRAULIC HAND PUMPS

Model 68-2000 Series

SIMPLER CONSTRUCTION *MEANS* FASTER PRODUCTION

Now In Full Production

The Model 68-2000 Series are now in large scale production...are specified for use in many types of service aircraft.

The Acme of Simplicity

Many precision manufacturing operations were "ingrown" out of the pumps...many difficult machining set-ups have been eliminated. Use of Pressure Mold casting process speeds production, saves metal and machining time.

Thoroughly Tested Under Severe Conditions

During life-tests, a line pressure of 3500 p.s.i. was maintained for over 120,000 cycles. Temperature tests ranged from minus 67 deg. F. up to 140 deg. F. Laboratory and service testing has covered every conceivable operating condition, and proved the superiority of the simplified design.

HARVILL
Corporation

HYDRAULIC DIVISION

Exclusive Representatives:

Harvill Processes Corp., Federal Trust Bldg., Newark, N. J.

"THEY'RE ON ALL OF 'EM!"

TRAINER
TO
TRANSPORT
FIGHTER
TO
"FLYING FORTRESS"
EXPANDER TUBE BRAKES
ARE
HAYES

FROM the Piper Cub Trainer to the Brewster "Buffalo" from the Curtiss C-46 to Consolidated's B-24, and the Boeing Flying Fortress.

Expander Tube Brakes are on the job, and they are Hayes designed and built. On these and other ships Hayes E T Brakes are in service around the world.

And civil use! . . . Take United—Penn Central—Western Air—Eastern Air Lines . . . Hayes E T Brakes are standard equipment. Reduced maintenance and better performance are proved.

In fact, every Expander Tube Brake in use in the United States is a Hayes product.

Among the components in Hayes Wheel and Brake Assemblies are the pioneering and designing by Charles Hallerich, Vice President, in charge of Engineering. Meticulous design and improvements, proved over long years of civil and military flying performance, are familiar elements to aircraft men. They know the assurance of reliability in controlled take-off and landing on Hayes equipment.

HAYES INDUSTRIES, INC.

Home Office: **JACKSON, MICHIGAN, U. S. A**



Berryloid Aircraft Finishes have long since taken their place among the world's best known and most widely used aircraft production materials. Their dependability, uniformity and practical shop qualities have

contributed much to record-breaking Allied plane production. A large majority of non-engine trainers, used by the United States Air Forces and the Royal Canadian Air Force, are finished with Berryloid materials.

BERRY BROTHERS

DETROIT, MICHIGAN • WALKERVILLE, ONTARIO

BOSTON • JERSEY CITY • CINCINNATI • CHICAGO • ST. LOUIS • INGLEWOOD, CALIF.

BERRYLOID
AIRCRAFT FINISHES





On the job . . .
at every take-off



From the list of Simmonds engineered aviation accessories, the following are in active production for the fighting forces.

Simmonds-Corvey
FLEXIBLE PUSH-PULL CONTROLS
CHROMOMETRIC BARBERSHARPES

Simmonds-Barton
SPARK PLUGS

Simmonds-Clear
HYDRAULIC ACCUMULATORS

Simmonds-Holman
INDUCTION PRESSURE (ROOST)
CONTROLS

Simmonds-Prattice
B30 ENGS

Simmonds-type
COWLING AND PANEL FASTENERS
IN CLIPS AND RINGS
QUICK DISCONNECT UNITS

AN ever growing number of America's hard-hitting fighting planes are equipped for efficient performance with Simmonds products. One or more items from the list of Simmonds aviation accessories is in action on world-wide fighting fronts with every American bomber in the air today.

Simmonds is proud that all its manufacturing experience and facilities are enlisted in the battle for Freedom. It takes pride, too, in the increased demands for the high quality, performance-proved products which it manufactures in quantity. Until Victory is ours, Simmonds precision-made parts will be "on the job at every take-off".

SIMMONDS
AERODIFFUSION, INC.

16 ROCKEFELLER PLAZA, NEW YORK, N. Y.

Market Place Building, Dayton, Ohio • 4050 Hollywood Blvd., Hollywood, Calif.

AVIATION, November, 1942



Bag Moulded PLYWOOD

Wing Tip for Navy Glider

MOULDED PLYWOOD Components Speed Production!

Many production delays can be avoided if Moulded PLYWOOD components are used in the construction of military aircraft. We

are staffed and equipped to help break the bottleneck in the industry and welcome inquiries from prime or sub-contractors.

Replaces Critical Materials!

An invitation from you will bring prompt quotations and recommendations from our Engineering Staff.

Fabrications of:

PLASTIC BONDED PLYWOOD AIRCRAFT COMPONENTS

Aluminum
Type

Golden
Elements

Brush Box Doors
Tail Gun Turrets

Landings Gear Doors
Flaps

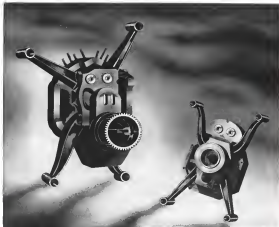
Gunports Lightings
Structure Doors

Door Structure
Mechanisms, etc.



AVIATION ENGINEERING
INCORPORATED

E. Edin, President, Executive Vice President and Chief Engineer
1290 BLASHFIELD S.E., ATLANTA, GEORGIA



why TUESDAY couldn't marry THURSDAY

It happened in an airplane factory.

When brought together on the assembly line, some close tolerance motor parts did not fit. Yet each part had been made correctly.

One part had been made on Tuesday—accurately. The other part had been made on Thursday—also accurately.

But Thursday was warmer day than Tuesday. A controlled expansion, due to the difference in temperature, upset the microscopic close tolerances of the two parts . . . thus preventing an accurate fit.

To eliminate the resulting waste and delay . . . air conditioning was installed to keep temperatures under control. It had to be extremely efficient, air conditioning—with some exact temperature and humidity. Previous air conditioning

—the kind General Electric is installing in many war production plants.

Today, air conditioning is making engineers' and designers' advances in building stronger warlike equipments. After the war, the lessons learned in making fighting equipment will be applied to living mans' new and interesting benefits to the general public.

Most people will enjoy air conditioning . . . in homes . . . in cars . . . and in even increasing numbers of stores, offices and factories. It will be vastly improved

air conditioning . . . in many areas. Temperature and humidity will be maintained more exactly than ever before. Equipment will be compact . . . service economical.

Today, hundreds of wartime industrial men are turning to General Electric for reliable equipment. In the future, G.E. air conditioning will fit the needs of all kinds of men.

Air Conditioning and Commercial Refrigeration Department, Division 223, General Electric Co., Bloomfield, N. Y.

Air Conditioning by
GENERAL  ELECTRIC



Howard Aircraft's DGA-15, transport and light cargo (pictured above) was easily converted to the G4-1 for the U. S. Navy. Because of the excellent record of this airplane in service, larger orders have now been placed for this craft to be used in cross-country touring.

BEST IN THE WORLD!

American Flight Training is the best in the world. It is taught unmolested in the wide-open spaces by experienced men who have the time and opportunity to do their work thoroughly in Primary, Advanced or Combat Training. The Flight

Schools from which they operate are furnished with the best training planes and ground equipment. The air fields are tops for the job. Howard Aircraft is proud to have a larger part in supplying these better airplanes.

THIS SUPERIOR TRAINING IS HELPING TO

"RULE THE BLUE IN '45"

Howard Aircraft Corporation

2841 WEST 24TH AVENUE, CHICAGO, ILLINOIS, U. S. A.

Powered below is Howard Aircraft's DGA-146 Primary Trainer, identical with specimens of CPT Primary Trainers. Because of the experience gained in producing this airplane, Howard Aircraft has been selected to build the PT-25, standard low-winged Primary Trainer of the Army Air Force.



Checked and Rechecked

To Insure Time-saving Performance!

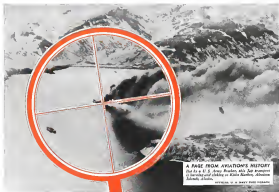


Parker-Kalon Socket Screws undergo a rigid check-up routine that can only result in time-saving performance

A Quality Control routine—without counterpart in the screw industry—wends out screws that fail to meet the high standards of quality established by Parker-Kalon. This check-routine begins with careful analysis of the raw material and follows through to the final manufacturing operations. It gives Parker-Kalon Socket Screws a degree of dependability that helps to make every working hour count in matters of war production plants, yet it costs no more to specify Parker-Kalon! Parker-Kalon Corp., 262-264 Varick Street, New York, N. Y.

Quality-Controlled

Complete test and inspection routine covers: Chemical Analysis; Tensile and Torsional Strength; Double Check Resistance under Tension and Shock; Hardness; Thread Diameter; Length and Concentricity; Thread Shape; Size, Depth and Concentricity; Thread in. Every detail is double-checked to insure the highest degree of workability.



A PAGE FROM AVIATION'S HISTORY
That is a U. S. Army Bomber, this day engaged in bombing and striking at Kala Namgyal, Abomey, French Africa.
OFFICIAL U. S. ARMY PHOTO GRAPH

Helping the Air Forces PUT BOMBS ON THE TARGETS

A bomber crew has one all-important objective—Hitting THE TARGET! Through perfect coordination of trained hands and responsive motor controls United Nations Air Force Bombers are destroying the enemy. Emerson-Electric precision-built Aircraft Motors are helping the boys up there concentrate on the job down below. It's like having extra crew members aboard—*instantly* available, always dependable.

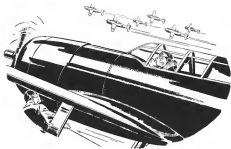


LIGHTWEIGHT, COMPACT, POWERFUL
—Aircraft Motors are only one of Emerson-Electric's contributions to winning the War.

THE EMERSON ELECTRIC MANUFACTURING COMPANY
 St. Louis • Branches: New York • Detroit • Chicago
 Davenport • Los Angeles

EMERSON ELECTRIC

5 H.P. and Smaller **ELECTRIC MOTORS FOR AIRCRAFT** 5 H.P. and Smaller



Trade Seats with him?

AXIS AIRMEN WOULD, GLADLY!

• He's the envy of every flyer under the Axis flags. He not only has deadly firing power and invincible fighting spirit, but he's the safest fighter in the air. And a big safety factor is the armored cockpit of his plane. Braving a hail of screaming projectiles, he needs the toughest kind of protection—tough

in shatter resistance, high in impact strength. For skilled and experienced sky fighters are precious and we must guard them well. Van Dorn employees are proud to share in the work of safeguarding American flyers. Building aircraft armor is their job—and they're doing it 24 hours a day.

THE VAN DORN
IRON WORKS COMPANY
CLEVELAND, OHIO



DESIGNERS AND BUILDERS OF PRISON EQUIPMENT SINCE 1878



*Handling the Giants
with*
Reverse Pitch

CURTISS

ELECTRIC PROPELLERS

Background of Production

Behind today's mass production of Breeze equipment for war stands a record of years of design and manufacture for the armed forces of the United States. Breeze Radio Ignition Shielding, Flexible Conduit, Fittings, and Electrical Connectors are but a few of the many Breeze products in use today on nearly every American bomber and fighter, as well as with our armed forces on sea and land. With all its facilities devoted to production for war, Breeze is helping to turn out the tools for Victory.



BREEZE CORPORATION, INC. • NEWARK, NEW JERSEY



Since the Industry was a *Fledgling*

AIR-MAZE PANEL TYPE AIRCRAFT AIR FILTER

Build construction the entire vibration from pressure and noise of high speed air motion. Patented design eliminates need for maintenance. Fully meeting the specifications of the Army Air Forces, AIR-MAZE aircraft filters are standard equipment on most makes of combat planes.

AIR-MAZE has "Kept 'em Flying"

AIR-MAZE protected motors run longer, safer, better. Extended time between overhauls is *extended fighting time!* A reserve of fighting life of vital importance.

Pioneering in 1926, AIR-MAZE has grown up with the Aviation Industry and has shouldered a pioneer's responsibilities. Fully meeting the specifications of the Army Air Forces, AIR-MAZE aircraft filters are standard equipment on most makes of combat planes.

AIR-MAZE CORPORATION

General Office CLEVELAND, OHIO

Leading supplier of General Air Filters to the Aviation Industry since 1926

AIR-MAZE

DEPENDABLE AIR FILTERS FOR EVERY APPLICATION

A message from MARS for Hitler and Hirohito



New, 70-ton Holley-equipped Martin-built Mars Navy bomber, powered with four 2000 h.p. Wright Whirlwind engines . . . world's largest flying boat

HOLLEY

AVIATION CARBURETORS

HOLLEY CARBURETOR COMPANY • DETROIT, MICHIGAN

people with a PUNCH

The spirit of personal sacrifice and extra contribution to the war effort is typical of Beechcraft employees, and is especially seeing among the hundreds of men and women of the Beechcraft Reserve Guard, some of whom are shown in review below.

These employees voluntarily drill and practice in their free time so that they may be ready to meet any catastrophe or emergency that may arise, whether caused by enemy bombing, fire, sabotage, or act of God. They have sworn to protect life, war material, and the plant, in the interest of the war effort. They come from all departments of the Beechcraft organization, serve without pay, and buy their own uniforms.

Other Beechcrafters are members of the highly efficient Volunteer Fire Department, and still others are members of the Employees Club and of the Workers Club. These latter pledged themselves not to shirk until certain high accolades in production had been obtained. Their heads are long gone but now they and the members of the Employees Club freely donate their own time to creating benefits for service organizations.

Production figures are the best proof of the devotion of ALL Beechcrafters to winning the war, but cannot be divulged. The next best proof is that Beechcrafters are voluntarily working, not 10%, but OVER 20% of their own gross payroll in War Bonds! And the next best proof that they are putting their hearts as well as their hands into their war contribution is their grim slogan of deadly earnestness,

"LET'S KILL 'EM WITH PRODUCTION"



Beech Aircraft

CORPORATION

BEACH AIRPORT  WICHITA, KANSAS, U.S.A.



"Store welding electrodes
in a dry place—
they will keep indefinitely
if properly cared for"



Always keep electrodes in a dry place — on a clean shelf or rack, or at least off the floor. Don't expose them to moisture, keep them away from sweating pipes and open windows. If by accident a box of electrodes should get wet, spread them out to dry immediately.

Follow these simple precautions together with those enumerated at the right — fight waste to speed victory.

A booklet of shop bulletin illustrating "do's" and "don'ts" has been prepared to help your welding operators get the most out of every electrode. We'll gladly send you as many copies as you can use.

Air Reduction

General Office:
40 EAST 42nd STREET, NEW YORK, N. Y.
IN 7743
MILWAUKEE - AIRCO GAS PRODUCTS CO.



OXYGEN IS PRODUCTION — Don't Waste it!

WELDING ELECTRODES ARE SCARC Help Prevent Waste

- Do not bend electrodes unless absolutely necessary
- Use electrodes down to a 2-inch stub
- Fit joints properly before welding
- Make legs of fillet welds equal
- Make the face of fillet welds flat



ARMY

E

NAVY

Proudly it flies

SYMBOL OF A PLEDGE UPHELD

TODAY, from the flagpole of the This plant in America, flies the first the "E" banner representative of the joint Army-Navy Production drive, signifying excellence in both Army and Navy production.

And, proudly, This employee wears the "E" lapel pin.

Fully aware as every man and woman of This of the significance of the banner which has come to them, They regard it, humbly, as the symbol of a pledge upheld.

MONTHS ago, the men and women of This gathered in the shadow of the plant and made a pledge.

The pledge was, "We'll Produce the Most or win a pledge made sincerely by determined people who know that the possible power tools they make would help to build the planes, the tanks and the ships with which the war must be won."

Months ago they repeated the thoughts that "To better, or lose, could be applied here. That's why shipbuilders leaving the plant have doubled, then doubled again have

resulted in more tools produced than anyone ever thought possible.

In our own way — in the only way we know how — we have added our part to the national effort that is so necessary for the fighting of battles whenever conflict arises.

For this reason, we look upon the word of the Army-Navy "E" as symbol of a pledge upheld.

To you, the men of This plant, we repeat this exhortation of the Army-Navy "E" — with the sure realization that our task is just begun.

Not while a plane is delayed in its departure, not while a ship lies waiting in the ways, not while a needed tool is unobtainable, can there be any feeling of negligence or accomplishment.

Today, with even greater determination, we reaffirm our purpose and our pledge —

"We'll Exceed the Need!"

That Portable Pneumatic and Electric Tools
INDEPENDENT PNEUMATIC TOOL COMPANY

101 N. MICHIGAN BOULEVARD CHICAGO 90
Branches in 100 and 1000 cities

When you land on oil and taxi on air



WHEN you fly, an airplane built for high-speed lighting at high altitudes, you can't expect to land it like a sailplane. Nor can you coast on runways inflated with smooth air. But with **GENDEX SPEEDRACER**® shock struts, you can be sure that of all runs the smoothest of landing wheels. And you can depend on their resilience at compressed air to level off the rough spots as you taxi. For landing gear built by **GENDEX**® are designed, constructed and tested with the single purpose of giving our pilots smooth, worthy of their skill.

SENDIX PRODUCTS DIVISION



Use the Mark Assistant "Shoring" for the "ROADS/PURPOSES/TC" block that is rugged, dependable, versatile. It anchors fast loadings and uses enough capacity "MAGNET" loading part is an important part of the "Mark" Core. It provides equipment which 23 bands plus from used to count are spending in the lighting cases on world's busy roads.

Aspartic Waxes and Esters: "PNEUMAX" 1000
from Kvaerner and Danisco/Total/Shell, Ethylene

Construction—Builder of Bases

America's Great Peacetime Industry Goes to War

PUNCHED through 1,600 miles of treacherous winter road and making the Fairbanks Canal is strategic importance, the Alaska Highway will cut days and dangers from potential supply routes to Alaska — to the Aleutians — yes, to Japan itself.

This job to be finished soon and well ahead of schedule, a hot new example is thousands illustrating how construction sets the stage for our war effort and why the construction manager is vital to victory.

Back of America's busy production lines, expanding shipyards, growing customsports and far flung military bases is a series of swiftly executed construction jobs. Important jobs! For the construction industry is a builder of bases—Bases for production—for training—for defense—and for attack.

This is the fifth appearing month of the publications, read one-half million daily newspapers, magazines and Weeklies dedicated to the part that each citizen can play in the recovery effort and in the nation's progress.

The civil engineers who develop the necessary designs, the contractors who execute them and the manufacturers who provide the equipment and materials, are as much a part of this war as are the men who face the enemy. The results of their labors are recorded in astounding production figures, and will be, undebatable, set on in the military records of this war. These 60,000 airplanes, 45,000 tanks and 100,000,000 tons of shipping that the President asked for in 1942 will be supplied because—and only because—the construction industry did a Herculean plant building job last—and this

Yes, construction, America's great peachstone industry, has gone all out for war. From a normal 6½ billion dollars in 1958, it got into its war stride last year with a 19½ billion dollar effort. And under the impetus of Pearl Harbor, the 1947 figure ran, promises to reach the unprecedented total of 35 billion dollars. "If buildings would win the war, Hitler would be kicked out," said Lucius G. Williams S. Kaufman recently. Which also explains the further fact that the construction industry was the first to go to war.

The technical and managerial talent that is accomplishing this mammoth job has had to find its strength and resources within itself. No possibility of "outsourcing" here! Only years of varied construction experience enabled it to tackle and to achieve the many field tasks that builders for war demands.

Take that cornfield, for instance, that Henry Ford picked for his record-breaking bomber plant. The

spring steel was soft and deep when construction moved in last year. They were entering a race against an almost impossible time limit. Before they could even begin on the plant itself, they had to build roads, lay a 4-mile water supply line and install a complete sewage system with its disposal plant. But each varied job—each lay in its own right—was done meticulously to running up the framework and enclosure for the 60-acre factory shell. On

It was a race against the approaching winter, and to win it they had to pour three 150,000-cu-yd worth of concrete equipment to the bank-day and night. But was this dirt? It is accomplishments like these that explain how the nation's aviation factories floor space increased from 175,000,000 to 60,000,000 square feet in 1960.

This is the fifth of a series of editorials appearing monthly in all McGraw-Hill publications, reaching more than one and one-half million readers, and in daily newspapers in New York, Chicago and Washington, D. C. They are dedicated to the purpose of telling the part that each industry is playing in the war effort and of informing the public as the magnificent war-production accomplishments of America's industries.

the past two years. Only 1,400 new and lighter ships are beginning to turn the scales of war in our favor.

"Somewhere in the Southwest" the Army called for a training base. The contractors who answered that call seemed up to performance in characteristic fashion. "Beginning without as much as a notion map we had a \$10,000,000 project ready for operation within 90 calendar days, and saved \$15 million dollars of the estimated cost."

At another Army camp a contractor assembled a crew of 20,000 men who put together 1,400 buildings in 125 working days along with a sewer system, a water supply and a street layout of which many a Los Angeles might be proud. This job involved up to 2,000 loads of lumber, and 26,000 logs of rock. So perfect was the teamwork, from the general manager down through the hundreds of superintendents and foremen to the specialized crews, that in many or seventy buildings were erected in one single day.

But versatility and experience are not the only qualities that the construction engineer has in his tool chest. He has ingenuity, and he needed it when steel, copper, zinc and aluminum had to be used for combat equipment, and were shorted him. Great luggers, converted from structural steel, were turned out with record loading timber and spars. Reinforced concrete fast boats were designed to require only 3 lb. of steel per square foot instead of the customary 5 lb. Asphalt impregnated paper was substituted for copper in tank tops, concrete slabs for galvanized steel as deck work. In the face of a materials shortage, he continued to build boats—swiftly, economically, and on time.

Construction ingenuity, too, is back of the records in Liberty ships, in war housing and a host of other activities. Indeed it was the construction industry that stepped forward to assume the bulk of the emergency shipbuilding program, leaving established yards free to handle more specialized Navy work. Naturally, it was one for civil engineers and contractors to build the shipyards, but building ships was another story. It is a far cry from steel ships to non-ferrous engineering structures, yet during years from bridge and building experience, the men of construction have turned out ships faster than their steel ones built before.

How was this possible?—because the construction man sees every job as a new problem, never expects any collect as something to be done in favor of some thing better. So instead of assembling the normal shop units piece of each ship on the ways he fabricated them into huge built-up sections. Those he rearing to the ways and welded them into place in a fraction of the time required by old methods.

Again, the demands for wartime housing for workers in industrial areas at Navy bases, and near Army concentrations, have stressed the meaning of "individual construction." The building of individual houses has

grown to be a form of multiple-unit project that offers the skilled services of the architect, the civil engineer and the large contracting organization. On one such project, for example, a contractor experienced in large building and bridge construction employed an extensive system of prefabrication and site assembly that made possible the completion of 5,000 houses for war workers within five months.

All these activities, within the United States, provided the achievement of other industries that serve the war at the front. But construction knows no continental limits. Its men are serving throughout the network of defense bases built in the West Indies, Greenland, and Iceland, and in the offshore bases that are taking form in the jungles and deserts of Africa, the harbors of the Persian Gulf, and the plains and mountains of Australia and Alaska. Already in this war, as in the last one, one construction crew, like those at Wake and Guam, have dropped their peacetime tools to fight shoulder to shoulder with their comrades in uniform. Construction follows the flag to the hottest points in this global struggle.

* * *

But while the construction industry thus serves the special needs of the armed forces, it must look after its job at home. It must keep the highways serviceable, the water supply safe, sanitation facilities adequate. These are home issues that cannot be neglected even in war.

And when we finish our No. 1 task of winning the war, the construction industry will again be called upon to help establish peacetime employment and to stimulate the normal industrial activities of the nation. It will race, redesign and rebuild; it will bring modern sanitation to urban dwellers, it will safeguard traffic and other from disaster floods, it will improve all forms of transportation, it will design and build the facilities that will be needed to convert our forces to peace. Its own versatility, experience and ingenuity will be as indispensable then as they are now.

Under it is building the base that we need back of every battle line. Sometime it will build for a race and better one. Today it is laying the foundation for the campaign that must be won. Sometime it will be the foundation for the peace that will follow these victories in war and in peace the construction industry is the linchpin, the backbone of nation's forces.

James H. McGraw, Jr.

President McGraw-Hill Publishing Company, Inc.

The Pattern of the Peace

ALMOST EVERYONE who looks beyond the tip of his nose is conscious of the fact that we should do some thinking about the postwar period now. But few men are so afraid that they will be offended if their interest that they are devoting one thinking hour to nothing but the American task in hand. Unfortunately, this is particularly true of the aviation industry, which has been arrested strongly in such and so often that it is a good deal of criticism and investigation.

If we look beyond our own industry we will see as such few of criticism. Even great industry is thinking for the future. The President of the United States and the Prime Minister of Great Britain gave the world a postwar blueprint in the Atlantic Charter. The Vice-President of the United States has gone on record as an advocate of postwar planning. Already federal agencies and committees are at work on the problem. It behooves all the members of the aviation industry to follow their example.

At the risk of being too bold and too far we present several elements of the postwar picture—a partial outline of some of the things we should be thinking about while shaving or while waiting for an airline seat priority to come through:

1. As long as there are men who aspire to rule the world by force, and there always will be, some means must be provided to keep them in check. No means could be more effective in keeping order than properly directed air power. We must guard against the temptation to terminate our military strategy when the assistance is stopped. We must create a community of nations with commonwealth to ensure their arbitration. This is a duty not only as members of the industry but as citizens of the new and better world for which we are fighting.

2. Means of communication in war inevitable become tools in the peace that follows. Our airlines, foreign and domestic, were only for the most part in their growth when this war came. The war has stimulated the time for development of useful airways by many times. We must take full advantage of this accelerated progress. Heavily service between New York and London and other routes of transportation will be needed before the war ends. We must realize the tempo of our thinking to the new tempo of business that this and other international airlines services will make possible.

3. Our domestic trunk line airlines were highly developed when this war was thrust upon us. With the flying equipment that we developed during the war, our airlines will be able to move forward to new ships with attitude in commercial service, mail and express service and consolidate this service with

intermediate feeder operations and local secondary services for passengers and goods. New jets—ways do not demand the expense of land-based service. The technique of our mail pickup and delivery by plane in flight has been perfected and will be used to provide air mail and express service to the smallest villages. The efficiency and flexibility of glider trucks will utilize state and border service.

These facilities will contribute their part to the solution of the problem of distribution which need be solved if we are to take full possible advantage of the production machinery developed for this war. And that productive capacity we are creating is so great that it will shock not only the air service but existing ground transportation facilities for proper distribution of its products.

4. The gliders we are training for our armed forces are tomorrow's business men. They will not be content to return to the old tempo of travel. They will demand personal airplanes for their business and their pleasure. Those who do not own their own ships will demand first-classment services. Airplane distribution and feeder aircraft will let their reliability offset in this era of easy business as they may, had sharp competition from the automobile made in the postwar period.

5. Automobile makers who aspire to be airplane manufacturers should realize that their first production efforts will be worthless if they are not supported by adequate design facilities, or aviation with well-developed design organizations. Airplane makers who have attention in automobile manufacturing must realize that customers will not beat a path to their doors. No matter how attractive their personal products may be, they will not sell themselves.

There will be no divide space between poverty and prosperity after this war. If we had no right on earth to the opportunities that lie ahead we will fail miserably. If we had the ways and means to distribute the goods we know we can produce, the world will be a better place to live in than it ever has before. We must approach the distribution problem with the same determination that we have demonstrated in the munition job we have done in producing the instruments of war. In this, as before, will play a tremendously important part.

John E. Hawks

AMERICA AT WAR

Amazing record being established by United States heavy bombers shows our strategists and designers were right from the beginning—to the delight of the British and chagrin of the Nazis. But, while United Nations' airpower gains strength at encouraging rate, we still have a long way to go to win the war.

MAJ GEN IRA C. EAKER, chief of the United States Bomber Command in Britain, says German industry can be destroyed from the air. The House Military Affairs Committee, after extensive hearings, says American airplanes are far superior to those of the enemy. The battle-splattered Eastland breaks two more rice sea lanes while rockets fight in the air almost exclusively. (Leaving, in an unusual speech, admits that his Luftwaffe is powerful just now to resist the blows of Allied air power, but still promises to even the score when Russia is in the bag.)

There you have a few scenes in the fast-moving world air war drama of aerial attack. There were still other vital developments. The United States launched a new aircraft carrier Lexington to replace her predecessor, and with this landing came news that the Taskforce also had gone down after killing some 1,000 Japanese in enemy planes and ships including three Japanese carriers sunk and one damaged, which was later sunk.

The Army captured the Anderson Islands, only 100 mi. from Japan, west last summer in the Aleutians, and went to work on the enemy with B-17's, B-24's, P-51's, P-40's, and P-43's. It was the beginning of a drive to push the Japanese off the island campaign, which we now want to use as our own road to Tokyo when the time comes.

Probably most inspiring to airmen and groundmen was the continued story of the combat performance of Boeing B-17 Flying Fortress not, more recently, the Consolidated B-24 Liberator. Many are surprised, including the British who had made up their minds that heavy night bombing was the key to the war game of Europe. Not the least surprised were the Nazis. Their newspapers have a well-founded report that a German radio message was intercepted which said that the Luftwaffe was at a loss for ways to stop the Fortresses.

Details of B-17 exploits are widely reported in the news, but not generally explained is the fact that Boeing engineers have been "beats" designers since the company's beginning. You can recall that the first postwar fleet of transport planes to operate in this country were the Boeing 40 series of single-engine pos-



International News Pic.

super-engine ships. They managed to be heavy and as resistant as a tank's target, yet they got over the mountains with a good load—more than double what previous planes of about the same gross (135 hp) had carried. They never wore out and neither did the exhaust system. It was that came after three. Incidentally, it was the "40" series that proved out the unusual engine for "dependable" operation, as the Pratt & Whitney people say on their name plate. All that working is to give background for the reason why the engine is considered to last that, he was about the *Pentosa* to prove, but the power don't fall apart.

The B-17—another with B-24's—have made (at this writing) well over 100 sorties over Europe with little loss and are threatening some of the prize concepts of air war. It has been supposed that single-engine land-fighting combat planes could not survive in daylight against closing fighter squadrons. But the air warplanes are beginning to wonder.

(Turn to page 372)



ABOVE: Progression landing, in which the United States has no competition is certainly proving its worth as battlefields around the world. The ship shown in the lower right is left one of the many Japanese vessels that didn't get away because previous landing has exposed both the British and Dutch—very generally and impressively respectively.

LEFT: On Pacific fronts American air power is getting its effectiveness as was demonstrated during the occupation of the Anderson Islands. Carrying B-17's into the war of the operation commanded by Maj John Charnell have been fighting under extremely adverse conditions along with P-51's and P-40's.

RIGHT: One of the new Boeing B-17 Flying Fortress bombers is being pulled up with an engine mounted against the four new fighter planes. Heavy rollers will move a Boeing B-17 over the side angle of fire which permits a fraction of these planes to clear a variable mile of the point of attack.



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some where large modern airfields are not available. This may produce what is popularly known as a "hot" ship, though it should be pointed out that the phrase really means a specially high performance plane which, if restricted in the past, may prove to be actually safer in traffic, both in the air and in landing. An example of the danger is the original German Heinkel He 111, a beautiful and sleekly designed fighter,

some and self-landing gun boats were built, but obsolete, as well. Aluminum shoring is very light, and the ground construction for them is good. Invariably both planes and the pilots are killed as "vulnerable," like tanks, guns, etc.

To gain the air superiority we need to win the war, America must have a sufficient quantity of high quality warplanes. We must have hundreds of thousands of well trained men—and that means weapons, as well as ground crews to "keep 'em flying." We must have our bases at strategic points, including landing fields, storage and maintenance facilities, housing and industrial installations, and all that goes to make a modern air force to carry on.

We must have an air supply system to maintain American Air Forces offensive actions on the far-flung battle fronts. Our training program, in the Flying Training Command and the Technical Training Command, have been expanding at an amazing rate, and

but in estimating our progress in the war for air superiority, and in order to properly estimate needs of the current demands of our airplanes, it is important to get down to brass tacks.

In discussing airplanes it is important to remember that there are others, such as 20,000 or 100,000 per year, some very little. The question is not only "What exactly are these planes to do and how? What type do we need? How many of each?"

The basic functions of air power include (1) Attack, (2) Defense, (3) Observation, and (4) Transport. Out of experience in the use to which airplanes are put, certain general specifications have emerged. Military airplanes are designed to meet certain specifications as to exactly what that airplane is expected to do. Each model is a tailor-made job. It would be very surprising, and far less expensive, if a single type of airplane could be designed and produced which would perform all functions, but

Builder Development is illustrated by the Heinkel He 111, one of the most widely used types in the Luftwaffe. Its performance had appeared in 1935 as a "monstrous" failure (failed engine, faulty personnel, slow a factor and more powerful engine required) and it was later in the Spanish Civil War. Engines have increased from 800 hp to 1,400 hp in the period. No He 111E has speed less than around 200 to 215 mph, and original armament of three 7.7 mm machine guns has been doubled and a 23 mm cannon added.

Factors Controlling Aircraft Design And Combat Performance

An authoritative analysis of American, British and German warplanes shows why record of United States craft is good and reveals fallacies in arguments of self-appointed critics of AAF planes—hitherto unrevealed glimpses of the future give sound reason for continued faith in our designers and builders.

By **NATHANIEL F. SILSBEE**
Major, U. S. Army Air Force

THE AIRPLANE WAS NOT ALWAYS a military weapon. Orville Wright has more than once expressed his sorrow that the machine, which he and his brother made a practical reality, should have been used for such English purposes. Quite early in the history of less or this air-craft short military runs

revolved the latest possibilities of the airplane to bring new speed, new range and new range to warfare.

As the airplane was applied in various ways in actual battle a few well defined types were developed. Multiple engines with a head-taking capability, but types remain fairly stable. B-17E is a model, heavy bomber is a type.

Each desirable quality in airplane performance calls for a certain property, and the various properties conflict with

each other to a considerable degree. The construction engineer's knowledge of his subject tells him what properties are necessary to produce the particular qualities he desires, and his skill or creative genius guides him in selecting the means as to obtain the most while sacrificing the least.

Thus it is practically impossible to get a high top speed without sacrificing the landing speed—sometimes termed the safety point—particularly in combat

but which landed on the ground very probably it has only been indicated, and has become a vital factor, noted only in the Heinkel He 111E and Fieseler Fi 156 Storch.

The last known example of the last kind "one man plane" was called out of it, and as a military airplane, the Heinkel Heinkel He 111E, as shown. To secure maximum safety, rapid climb and high altitude not only were all pilot safety factors such as protective

and without the first ground crew, in amount and in the thousands, every month. One engineer and construction crew have been how they will even a total rebuilding the necessary, as have, for across in the same down to it. But in this paper we are concerned principally with the airplane, but don't forget the other three elements in making up a modern and powerful air force. Some of the following points will appear elsewhere, in other readers,

that simply is not in the realm.

It is how that engine of two engines have in actual use, proved surprisingly versatile, and with minor modifications are in business, from the first different planes built. These engines had a right to exist. The last example of this is the Douglas A-20 light bomber, used in the RAF as the Boston III for made in standard form and the last. Douglas will be. American made in the service of this bomber. It just about con-



plein the circuit when we note that some of the worst models have been equipped to carry torpedoes. Here is a somewhat plus, but the reason is that specific items for the attack bomber type (as distinct from an American development) in the long range heavy bomber are far less satisfactory than for other more standard types, in addition to which the engines of surface have a way of producing trouble especially in an aircraft carrier.

The main combat types are fighters and bombers, and the support types are observation planes, cargo and transport, and trainers, including primary, basic, and advanced single engine (the lightest jet trainer), and advanced two engine

surveys of the Indian. A good average is between 10 and 15 ft. In 15 ft. the N 17E and G 4E are both about 12.5 ft. From a design standpoint this means a large airplane with high lift wings, which have many characteristics. To some extent, the large, low-winged aircraft, such as the 747, have a low bank angle in the steep climb. This is one of the important differences between the British design, such as the Starling and Conquest, and our large-range B-77 and B-24s. The former were designed to carry loads of six to eight tons in height 600 to 800 ft. at altitudes of 25,000 ft. The latter are designed for high level flight, precision bombing at high speeds.

lances, which was refined by the Luftwaffe in the early 1930s and developed in the Spanish Civil War. The *Junkers Ju-87 Stuka* (German: *stör* = bomb; *er* = "diving" [after]) was used with devastating effect by the Luftwaffe against the British in the Mediterranean. The *Stuka* was a low-altitude development of other aircraft (now included in light bomber category), using fixed, low-flying planes for ground strafing targets, communication drops, machine gun emplacement, etc. The *Stuka* proved extremely effective when used on infantry, as it was able to land on the battlefield before, but not over, the enemy's front line. It remained in use until the war, with the RAF being particularly one of the

Porter has a smaller version known as the A-34. The Vulcan A-32 Fragmaster is a secret model, built for the British. The Army equivalent of the Carfax B12 C, Smith's *Robbitts II*, is the A-35 which is expected to be the most powerful dive bomber in any service. A dive bomber version of the Scarth American P-3 Mustang is now in production for the Army Air Force.

As fighting, hardly less important than on a stick, has two main purposes. First, defense—the extirpation of hostile invaders—and second, offense—penetration into enemy territory. Starting on a stick. For this, in fact, purpose, modern fighter planes have been developed by different countries, which, on the whole,

An excellent illustration of this is found in the engine data card found in the cockpit of a German Fieseler-Welt PW 108A shot down by the R.A.F. Its rate of climb showed "3,000 ft. per min. at 4,000 ft. with supercharger in M gear, and 3,280 ft. per min. at 17,000 ft. supercharger in H gear."

Compared with the 2- or 3-in/s generation speedometers the turbine-driven supercharger is more flexible and provides a greater range of altitude at which maximum power can be obtained. The design compromise in the nature of high speeds at all altitudes has not yet gone beyond the stage of practically two types of fighter planes: for sea Army Air Forces, those at normal altitudes

work. The Hawley T₉ plow, with Napier Series 2200-hp engine is reported in production, and from all indications will be faster and more effective at high speeds.

The Germans have three first-line fighters, all with fairly high ceilings. Fastest is the Heinkel He-113, powered by a Daimler-Benz DB 601 quarter-8 engine at 1,500 hp, but the other two, the Focke-Wulf Fw 109, and especially the Messerschmitt Me 109F, are more effective at high altitudes.

General rule is important to speed as velocity or altitude is high. Heavy loads, approaching at 20,000 ft. at 300 mph, produce 6 or more g-forces. If the fighter planes require 6 or 7 g's.

[illegible]

lighter glass design is always a compromise, as is illustrated by this first prototype of a Age One inspired alcohol bottle in the Atlantic. At least one of drink, mood, maneuverability and both confirm have been sacrificed off protective some: both the press down and oscillate light mechanisms which prevent difficult maneuverability problems. Early feedback by American adults, a United States States member.

(for training of bomber pilots, bombardiers, navigators, aerial gunners, etc.) For the most part we shall consider only the combat types. Each has detailed design specifications in most major performance requirements.

Of the four fractions of our power attack is fundamental, and air power should be regarded not as primarily concerned with air-ground fighting in the air, but as attacks on vital ground objectives from the air. That means bombers, fighters of any air force.

Primarily, the bomber must be a good weight carrier, with sufficient range to reach distant targets and still get back, with allowances for adverse conditions. The yardstick for both heavy bombers and cargo planes is power-loading—the gross weight divided by the total horse power, and the lower the number the

These considerations are fundamental for a teacher, but hardly less important are the factors of speed so that emergency phases will not be able to be fully crossed off, and ability to carry a heavy load to high altitudes to escape the worst naturalistic fire which has been developed by practically all the hellfire nations, now effective up to approximately 35,000 ft. Responder horsepower and pump-drive or turbo supercharging are the answers to these problems. From a military standpoint a conclusion to high altitude performance is the greatest advantage.

An excellent example of the need of highly specialized designs to meet specific performance requirements is the dive bomber. For more than 50 years dive bombing has been a specialty of our Navy and Marine Corps and, as it will

During the 1960s, however, under new conditions on land—and definitely at sea—the dive bomber may still be an important phase on a specialized type.

Although there are still large numbers of aircraft carriers, the numbers of conventional dive bombers (such as the Luftwaffe's one-engine Junkers Ju-243, which came out in 1939) also used as a level bomber for short-range bombing and long-range reconnaissance, that "all-weather" type, the B-24 Liberator, and the B-26 Marauder, the Dornier Do-217S strike bomber, the backbone of the Luftwaffe strike force, as two-engine heavy bomber types have not yet been extensively developed in Germany, the Focke-Wulf FW 200C, Krieger and the Stuka 217 being the principal models in the fleet. The Luftwaffe's new four-engine bomber, the Heinkel He-219, is being developed by the SPD, Gotha, and the Army Air

have proved to have similar characteristics and occurrence.

Design Feedback

The shifting requirements for a single-seat fighter plane constitute an unceasing engineer's nightmare. First of all is speed, speed sufficient to exceed that of enemy bombers and fighters at any and all altitudes. That problem of increase speed at any altitude is one of the most difficult of all. Owing to the fact that engine power falls off as the airplane goes higher and higher, every military plane has a critical altitude at which it performs best, depending on the supercharger.

about 10,000 ft. with a service ceiling up to 20,000, and the distinctly high altitude jets which operate effectively up to 30,000 or 40,000 ft. with carburetor-chargers. (We don't know yet if some of our other planes can fight effectively up that high.)

In the West chain we have the Carlin P-38 series, the Bell P-39 *Ancaster* and the North American P-51 *Mustang*. In the high altitude class we have the Lockheed P-38 *Lightning* with two Allison supercharged engines, and the Republic P-47 *Thunderbolt*, powered by a 1,550-hp *Double Wasp*. The British use the *Mosquito* for low and medium levels, and the newest *Spyder* for high altitude.

to reach that altitude, the landers will have progressed between 30 and 40 m during that time. A high rate of shock absorber deflation to intercept the moons more quickly, a feature very prominent in German design. It is also of interest to note that the Jap Navy X-3 has this as its breakers characteristic.

The conflict of design features between high speed and fast climb reaction is still in this: speed requires high power and low drag, small wing area and higher streamlined fuselage. Climb demands high power and large wing area compared with total weight. Not really, as usual, a compromise.

[Turn to page 267]



Stepping Stones to Action

Growing use of twin engine planes to train bomber crews as complete team speeds program with increased efficiency and means additional types to add to spotters' recognition lists

FLYING through practically all daylight and night hours in every part of the United States and Canada are growing numbers of them—the plane trainers, engine planes in which bomber crews are being given training as complete teams.

These AT (Advanced Training) planes have proved to be an invaluable stepping stone for both pilots and crews as the transition from primary and basic training up to the big twin and four-engine long range bombers. By now not a single combat zone, there has been a great saving in operational equipment, since bomber crews formerly had to train on either single-engine or bi-planes, and then on the big bombers.

One of the first to go into service was that built by Cessna Aircraft Co. About the time hostilities broke out abroad, Cessna had put completed tests on a new twin-engine five-place cabin plane designed primarily for private use. Quickly adaptable for military use, it was used and tested immediately in the Royal Canadian Air Force, where it is being called the "Cessna Navigator" of our own air force brought in for the full test, the first of which were completed AT-8; later models, very much in appearance, are designated AT-17, as the Robert

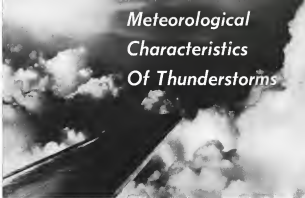
The AT-8, shown here, has a wing span of 41 ft. 11 in., a length of 32 ft. 9 in., and height of 10 ft. 11 in. and is

powered by two Jacobs LM6B radial engines. The fuselage is welded steel tube, fabric and duralumin; the wings are full cantilever steel structure, fabric covered except for the tips and leading edges, which are plywood covered. Another early entrant in the AT field was the Beechcraft, with the AT-7, which has been used extensively for engine training. Then came the AT-10, almost entirely of plywood construction, and powered by two 200 hp. Lycoming six-cylinder Vee fours, while the other Beechcraft, it has a single motor. This was followed by the AT-11, a low-wing all-metal craft and for specialized training of bombardiers and gunners. It is equipped with flexible guns and bomb racks for simulating a crew of three or four men, depending upon the operational mission. The AT-12 has a wing span of approximately 47 ft., and a length of 35 ft. It is powered by two 450 hp. Pratt & Whitney engines.

Latest of the new trainers is the Fairchild AT-13, the first of this category to meet specific landing gear order for that used on operational planes. It was described on page 225 of *Aviation*, August, 1942. Built about 100,000 of plywood, the AT-13, however, it has a wing span of 53 ft. 6 in., length of 37 ft. 11 in., and height of 23 ft. ("New Aviations," October, 1942, p. 260 for "True Training for the True Trainer")



Meteorological Characteristics Of Thunderstorms



Photograph by Getty

PART III. Last month the duration, movement relative to gradient to winds, and circulation pattern of thunderstorms were discussed. In this concluding article, the energy characteristics of thunderstorms are analyzed including the storm accumulative factors and energy equation. In addition, some helpful suggestions to pilots are given.

By GEORGE N. BRANCATO,

Assistant Meteorologist, Hydrometeorological Section, U. S. Weather Bureau

THE VIOLENT AND OFTEN destructive spiral winds during the early period of thunderstorm as well as the circulatory vertical velocities, frequently exceeding 200 mph, as the result of the storm cloud are a source of interest not only to the pilots, who often have to fly through them, but to the public in general. One of the best descriptive and explanation of these violent winds is given by Thompson¹. In making use of the deep network of stations in the Mississippi watershed and the daily soundings taken at nearly Wright Field, Dayton, Ohio, it has been possible to substantiate his explanation of these winds and make some additional suggestions. Thompson explains that "the presence of a cumulo-stratus cloud, however large, so long as no rain is

falling from it, does not greatly affect the direction and magnitude of the surface wind and does not bring on any of the familiar gale and other thunderstorm phenomena. Hence, whether or not, the rain is an important factor, both in starting and in maintaining the winds in question, but they do not exist before the rain begins to descend after it has risen. On the other hand, it must be assumed that this rain is the whole cause of these winds, for they do not accompany other, and unknown, causes, because heavy the downpour may be."

On this, it is shown three stages of cloud development for a thunderstorm. The first stage shows the structure of updraft air due to the establishment of an approximately subsiding layer table

in the base of the cloud. The third has reached its maximum magnitude stage and the upward circulation current is becoming rapid but the reorganizing downward current is relatively subsiding and greatly in the second stage the cloud is developing into a cumulonimbus, just prior to the beginning of rainfall. Here the upward vertical velocity due to convection and the release of latent energy has increased greatly, but since the compensating downward current is relatively subsided as compared to the unaccelerated rate of rising air, the downward current is still comparatively slight gently. The third stage in the fully developed cumulonimbus, rain and dense the structure which have now developed is a multi-cell falling rain. There is built a vigorous ascending and descending current, the latter frequently being in excess of 40 mph at its ground level and the former occasionally being referred to as an "anvil" because of its more sudden in descent.

Proper Feeding Boosts Worker Production

By LUCIUS S. FLINT

Extensive tests conducted at Douglas Aircraft Co. plants over many years prove that careful supervision of worker nourishment and eating habits pays big dividends in better production and morale.

BACK IN 1917, two workers at the Santa Monica plant at the Douglas Aircraft Co. were known as "Eggs" and "Thompson" because of "eggs" in the kitchen. They hadn't much regard for the matter—only a 512 ball between them and they were promoted at once. Here were hundreds of men doing precision work on airplanes. These jobs took a lot of energy. And sometimes the old man's supply would run out between meals.

"I bet the men needed some more food," the two workers reasoned—quick, an experiment that could be acted right on the job without loss of time. So, they decided that lunch in several hours of work, lunch and set up shop in a lunch room.

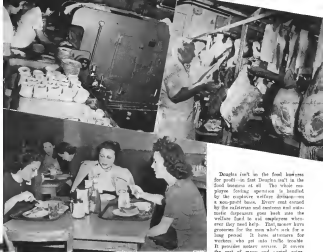
"Sixteen men and Thompson dropped a sack to the base at the next hour—"If you're hungry, come over and get a really hot!" The men agreed. That first day the "partners" sold out and increased their earnings in some ways. In a few weeks that same thing was much heavier. The lunch room wouldn't hold a day's supply of food. And the morning thing was that

production began jumping about in direct proportion to the amount of energy consumed. The morning would be reported in his statements. "Word got around to President Donald Douglas, who, being a thoughtful man with progressive ideas, came down to investigate."

A few days later, with due official blessings, the worldwide workers had a portable canteen and were producing candy off from the plant. Since they added soft drinks—and there are many here and they understand. And, the more they sold the more work the plant—workers' demand to do.

Thus began the present mass feeding operations at the Douglas Aircraft Co. And that was introduced a new theory to the handling of men—the theory that ability of a man to produce depends very definitely on what he eats and how much of it.

As a result of the early Santa Monica experience, Douglas officials became very much "food-minded." They recognized Alexander and Thompson in regard their service and their in establishing permanent canteens. Later



TOP AT LEFT: Modern equipment, such as this automatic dishwasher, expedites group feeding of thousands of aircraft workers and maintains highest sanitary standards.

TOP AT RIGHT: Douglas has provided the food plant manufacturer to increase the variety of household necessities available to workers. Such necessities, served according to need and right include eggs, chops, chicken, and potatoes.

MIDDLE: Recognizing that good food alone is not enough, Douglas provides pleasant, unobstructed cafeterias at several locations. In addition, portable canteens move out to the very centers of plants and make ready between meals.

BOTTOM: Employee feeding is handled in an exact science at Douglas plants. By specifying and carefully checking all food and studies are designed to select and balance meals, including vegetables and fruits.

on the company's stamp of approval was placed on the opening of the first canteen at the Santa Monica plant.

Today, Douglas has canteens from one to a dozen at many locations in each of its plants—the use of which is wide and known to all workers. And, the management insists on good food of its production record in the food department in those canteens.

"Careful tests have disclosed to be used any reasonable doubt that the man who eats these good, hot meals a day and who has access to their energy between meals. If he needs it—in the form of energy and will produce a better product," says Donald Douglas. "Good food, hot food, increases the general standard of health, it means fewer lost days, it means fewer accidents, it means less material spoiled, it means more work of better quality."

Douglas isn't in the food business for profit—in fact Douglas isn't in the food business at all. The whole enterprise feeding operations is handled by the corporate welfare department—a non-profit basis. Every cent earned by the cafeteria and canteens and other mass dispensers goes back into the welfare fund to aid employees whenever they need help. That money goes to the man who's sick for a long period. It buys attorneys for workers who get into trouble. It provides medical services. It covers the cost of more and varied entertainment. It helps the worker in just about every way he could desire.

And, still the employee gets a real value in food. For Mr. Douglas has a word that will surely be the best of all—a word that is a completely repeated restaurant would probably cost from \$10 upward.

The mass level of modern, fast in volume buying and in modern, modern kitchen equipment which thousands of employees have in food preparation and service. All people living for the service cafeteria in due through central headquarters—while better for the mass, outside of the food industry knows how and how and so on.

High laborers. Workers in all the plants provide their bread and rolls and rolls and pies and portions of the food possible quality at a cost far below the commercial price. For, automatic vegetable peeling prepares enough potatoes for thousands of men in a matter of minutes. Automatic dishwashing equipment washes and dries everything (Turn to page 224)



Horsepower literally floats on Timken Bearings

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"KEEP 'EM FLYING!"



Timken Tapered Roller Bearings have given highly successful service in Dynafocal suspension assemblies.

The bearings are used in links spaced symmetrically around the engine mounting ring and connected to the rear of the engine. Each link has two pivot points; one a tube and the other is formed by two Timken Bearings pressed into the link forging. Through controlled directional spring restraint, this flexible mounting arrangement results in a true center of gravity support for the assembly, the isolation of vibration and yet contains sufficient stability for landing and erratic flying.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of Timken Tapered Roller Bearings for automotive, service trucks, railroad, ship and marine, and all kinds of industrial machinery. Timken also makes and distributes roller bearings, ball bearings, roller bearings, and roller bearings.

TIMKEN
TAPERED ROLLER BEARINGS

Timken Bearings permit the links to float freely. They must carry radial loads set up by the thrust of the propeller plus weight of the engine and thrust loads resulting from propeller torque. Here is still another instance of the "know how" possessed by The Timken Roller Bearing Company in applying bearings in unusual applications, particularly aircraft.

*An aircraft
speeds and loads
increase the advantages
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designs study bearing
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MANUFACTURING SECTION OF AVIATION...

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Wood Techniques

Developed In Glider Construction



Fig. 1 Missing features of welded steel assembly shown while shaping skin is glued on and metal fillets applied. This steel mold spaced 7 in. apart and used to track skin to each rib and stringer used ribs. The problem of applying and connecting these quickly was solved ingeniously. Each two sheets by 50 in. wide 1 1/2 in. particle board. These wood glued panel is placed a strip of 1 in. square balsa (then the paper disk only). Nails are driven through strips, bent and skin side ribs. After the glue is dry, each one is easily pulled out by yanking against the surface holding. The final skin is the situation but just have track to place the wing.



Fig. 2 Doubling the leading edge of the wing is a difficult operation done by girls. It is glued and sealed to the tips of the ribs between which it is inserted. This edge must be straight, the correct distance from the rear wing one and the ribs at right angles. The girl doing the leading edge is daily beneath the wing. The other girl is pulling the leading edge into place at exactly the right distance from the rear. Royal steel balsa frame demands keep ribs in exact alignment and of proper height while glue is drying.

"Furniture City" craftsmen working toward large-scale production of transport gliders. Wooden fixtures and hot-press drying are features of wood construction technique.

FIFTEEN YEARS AGO, aluminum and steel began to replace wood in aircraft, the present welded monocoque is a metal, not a woodworker.

But the shortage of steel and aluminum has changed this picture. One of the most important Army Air Forces programs today is to provide transport gliders without adding the cost of the aircraft industry of critical metals. Low-cost-wood construction was the logical and actually practicable way to do it. The important problem was to find a source of supply—a community where there was available factory space, outside tool equipment and experienced wood craftsmen. What could have been more logical than to turn to the furniture industry—the "Furniture City"—Hood Riggles?

A large aircraft producer got the order for building these new plywood transport gliders. The next step was to build manufacturing facilities to turn them out fast enough to meet Army Air Forces requirements. The quick action required on this job could never have been planned without the wholehearted cooperation between two unrelated industries. As a last-minute problem, it required a responsible third intermediary, Hood Riggles Industries, Inc., supplied that link.

The accompanying photographs and captions explain how accurately the parts are held in dimension in special jigs and fixtures, also some of the special equipment that was developed. Few industries were better equipped for a job, plants are able to use almost 100 percent of their woodworking tools. In a few cases, new tools were added because of the use of parts to be finished. The open shaper of Fig. 1 is an example. What gives, during of glass parts is another thing not common in the furniture industry. As H. E. Johnson, factory manager of one plant, said: "With this method of gluing parts we do to 1 1/2 in. what it formerly required 3 in. and 12 men in a week." (Fig. 2)

The tracing of parts is made easily available, not taken on many small scratch parts in producing rapidly. Other craftsmen now do most of the planning and jig work.

Complete metal jigs are not used, except for drill guides. Instead, the workers use heavy plywood boxes. At one place, all drill fixtures are covered with state-graded plywood tops. Tops are held in place by the screws in holes which hold the wood or metal clamps to the plywood base.

Formed plywood is used in many places. The leading edge of the wing is one good example, the wingman's footboard. Also many right-angle concrete handle some bases.

Our assembly requires over 5,000



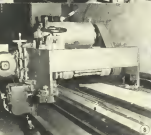
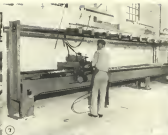
Fig. 3 Check-up of wing assembly before. Right one finished attached to the assembly lead handle and rib exactly. At this point the leading edge section comes, as is substantially with the last year. The balsa board held front and rear parts together while the ribs are inserted and glued. When all ribs are in place the skin for one side gets to be glued to them. Then steel box in the background of the side of the wing and the ribs together of the lead.



Fig. 4 When the woodwork is finished, wings must be covered with fabric. Strips of felt are applied by the workers. After the wing has covered they are sealed on the inside of wingman's footboard and shaped. Then after drying and final inspection of fabric they are released to the wing built for their next part. The down-drill under wing built was made by the Hood Riggles Wood Shop & Steel Structures Co. for this particular work.



Fig. 5 All skin on cutouts with balsa strips between ribs. These strips are carefully spaced with a double checked edge shown in the picture, while they are being placed in place. Special is getting into production tools if necessary to hold the glue in the place. A hot glue is used, taken from a corner where-glued towards the skin. When at 75 in. distance the appearance of the plate. It cuts from 1/2 in. to 1/2 in. in 1/2 in. in.

[illegible]

places—all plant species and communities are preserved as a unit.

Work is strictly subdivided, and its control is centralized. The work of each plant is planned and checked by the flow of parts, a control warehouse is used by G&L into this go no work external, when assembling and control items purchased outside. From this are distributed to plants required components. In the plant assembly line, G&L is the plant material supplies, sometimes, ready for shipment. This warehouse is supervised by ARMS in-pedants to expedite the flow of correct and accepted material to any factor, is the G&L group. It is considered one of the most important means in controlling the delivery of so many components, and the control of the flow to the successful operation of the plant.

Frederick H. Mueller is president of G.H.L. He said "Our farmers want-

[illegible]

PS 32. Women of all ages find this such easy listening. More or less of Garrison's page it is. It's a nice getting on the page. And we started at the top, then the making error went to the shelf below a bit at the top. Most. These are just one or two of the other and changed. At the night in the background, one should have about which takes about 4 h.

between tried individually to get aircraft work without success. The Furniture Association tried to get aircraft work, to no avail. Individual incomes were too small; the association was a collective organization that could not make contracts. We wanted to do our bit toward winning the war, but could not seem to get anywhere. Then Grand Rapids Industries, Inc., was formed.



Every member of the General Graphic Facsimile Association was invited to participate. Representatives composed the association and together, paid a \$180,000 in cash capital. These first members represented members of our \$18,000,000. This put their factories in a position to subcontract with anyone. We put our orders for glass in May and were making deliveries within 30 days. The only big problem we had was not facilities but how to organize them so that they would do business with the government. We have been told that this setup is a model one and no approach the company."

Stephen P. Dixon, secretary of GRT, stated: "We followed a special WPA procedure in forming the GRT. We are equal suppliers for all contractors. The furniture side of our business is still run as an highly competitive basis as ever. The important thing about our set-up is the agreement that each member 'will render their production facilities available for the manufacture of products, at parts thereof, described in or covered by any and all contracts or subcontracts for war work obtained by said GRT.' It is workers not most importantly. Therefore, it is because there is no promotional stock in the organization."

FIG. 14. After pieces shown in Fig. 13 are placed they are given two coats of gray enamel. Great care is required because a great amount goes on part of the bottom, and this will not show on a finished surface. Means, each member must be very careful not to get enamel on a surface where it is to be applied. Special drying racks are there in the background. These hold bottoms so that they will dry properly and rapidly and put out fresh air.

FIG. 15. Great pieces for both hands are the various supporting devices. It is not given a couple of days of roughing. Making them is carefully applied to surfaces to be glued in enamel will not prevent glue from adhering. These the operators are careful to apply without distortion. Faces are done on the line in the background when they build the bottoming.

FIG. 16. When a sample of drawings is done of making a shell for the mounting of metal parts, the two pieces always be held the metal in place. It is particularly necessary of the great shortage as to use much about under steel shell-making which, whenever possible, is the best possible in case steel supports because they are shaped to allow metal to be mounted in the future. All drilling is done with portable electric drills. Drills are thought to keep the drill mounting and level of through the drill housing with both hands. The weight of the shell is all that is necessary to take it into the mold. The entire fuselage is held up in a 10-ton platform being lifted with an 8-ton power-driven top. However, while the power used is a plant to the ground, only the fuselage body held it in place.

Developing Graphic Illustrators

"Reverse" approach to personnel problem proves advantageous in creating isometric drawings for production and service line workers.

By R. R. WIESE

Aviation Executive Engineer, Phillips, Inc.

IN AN INDUSTRY such as aircraft manufacturing, which has grown to large proportions almost overnight and which is in such dire need of experienced personnel, it is a valuable asset to have a source of manpower which has been previously largely unutilized by war production plants. In the development of its graphic illustration department, Phillips has found just such a source.

At the outset of the emergency a number of aircraft manufacturers recognized the value of providing graphic draftsmen—more substantially, consider those dimensional drawings—rather than relying wholly upon mechanical drawings of hot new dimensions.

"But who will we get to make these drawings?" they asked. "Draftsmen—even though they may be first class draftsmen—are trained in working in two dimensions and are therefore not prepared to handle the graphic draft work—that is, without further aid or training."

The result was that these companies decided to select some of their own outstanding draftsmen, send them to an school for training in three-dimensional, perspective illustrations, and then assign them to the new work force at Phillips. The reverse approach has been used, and used with unusual success.

In establishing the graphic illustration department, it was realized that for many draftsmen lifted from the rule-a-replacement would be needed. It turns, then, would endowmen be just? Draftsmen are scarce. We realized too that such valuable time would be lost while the men was spending time in one mode in an industrial art school learning how to work a fresh hand in three-dimensional work. Doubt of that thinking was to apply the conventional approach and start out on a pioneering task.

It was decided to employ full trained mechanical artists, men who had previously been exposed to advanced systems, department drafts, or independent art organizations. The fact that these men were relatively unfamiliar with aviation drawings proved no deterrent at all. As John Glavin, head of the department observed, "Our practice has

been to take artists when work there attention to detail and robust ability to work about as well as a thorough understanding of perspective. Skipped getting one to length in less than two weeks. An artist is naturally able to visualize, and once he has learned to understand engineering drawings, it becomes fairly simple for him to transfer mental ideas from shopmen. Teaching a draftsman to draw in three dimensions is a much longer process than the

simple procedure of explaining three-point viewing to an artist."

The upshot of this approach has been that it has led to the tapping of a personnel market which is readily available, particularly so in view of the extended shortage that artists have experienced, since advertising for a large number of large scale technical people has been closed.

Phillips has, in many other cases, (Continued on page 222)

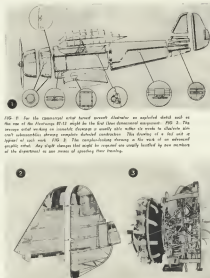


FIG. 17. For the conventional setup based aircraft illustration an exploded detail such as the one of the drawings 17-17 might be the first three-dimensional viewpoint. FIG. 2. The reverse approach is working in isometric drawings a usually side view which is directly into the illustration through complete detailed construction. The drawing of a fuselage and its support of each work. FIG. 3. The construction drawing in the work of an industrial graphic artist. Any slight changes that might be required are usually handled by new members of the department in new series of applying their training.

DESIGN CONSIDERATIONS For PLYWOOD STRUCTURES

The first in a series of vitally important articles setting forth fundamental information needed by every designer of plywood aircraft. This article is an "orientation" piece outlining the fundamental characteristics of plywood from a design standpoint.

By L. J. MARHOEFER, Chief Engineer, Ford-Bessel Corporation

DESIGN of an aircraft must be based on a clear understanding of the characteristics of the material being used. While most of the early airplanes were constructed of wood, the advent of the steel and aluminum and high development of aluminum and magnesium alloys has, and inevitably, resulted in wood being pushed well out of running as a prime aircraft structural material except for light, "auxiliary" structures.

It must be stated at the onset that the present air has had little to do with the incorporation of wood as applicable on an important scale to aircraft construction. This development has been growing for a considerable period and reached a highly, particularly stage prior to the war. The war has resulted in an accelerated interest because of the apparent occurrence of material shortages, but of more importance it has resulted in an interest that study of wood as a structural material because the most possible material or combination of materials is being sought for aircraft to win the war—and for post-war aviation.

It should be further stated at the outset that this information cannot be taken as a material of particular character but by applying these criteria established for materials of different characteristics. To put it bluntly, metal airplane design cannot be applied to wooden airplane structures in the air, or stronger for strength, with any full degree of efficiency.

The fundamental characteristics of wood as given by the Forest Products

Laboratory, and accepted as standard for design, are well demonstrated by using wood as a typical. The material is not isotropic with a great measure of anisotropy. It has a low density (approximately 0.45), a good value of tensile strength parallel to the grain, and reasonably good compressive strength. One of its most serious short comings is its low shear strength, which compared to its tensile strength is a ratio of 1:20-30:100, whereas, in steel, the ratio is 1:1000-1500.

The low value of shear strength and tensile compressive strength perpendicular to the grain is overcome by cross-banding layers to provide a more nearly uniform strength in both directions. This is plywood. Recently, the strength of the wood is somewhat enlarged by the cross lamination, but the shear strength under load are different. Obviously it is possible to provide almost equal strength parallel and perpendicular to the fiber system by adjusting the thickness of the cross bands and face layers.

The suitability of wood as an aircraft material is well attested by the many aircraft constructed of wood. Its durability, when properly protected from weather is demonstrated by the number of Lockheed Vegas still in service, for example. True, the wood has been sliced into pieces of veneer and put together again as plywood, but these steps of slicing, lamination and bonding are not nearly so involved as the factors to which a material of aluminum is subjected between its natural state and its



isotropy as a finished airplane

Meeting the Test of Shear

The reason that low shear strength values of natural wood is a most serious shortcoming is that in the joining of various parts of a glued structure, the shear characteristics are involved, primarily. Acceptable stresses in this plane were formerly taken as only 500 psi for supported structural joints, and the bonding depended on the low stressed joints being this plywood and water knots in obvious. This does not mean low shear strength, so far as wood is concerned, but the fact that wood joints may be held in as sharp as 2° in radius, and a side glue surface provided with the use of a glue block (Fig. 7).

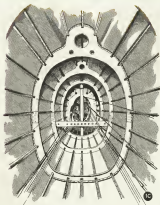
Another type of shear commonly en-

countered in aircraft structure is in a joint with varying shear stresses across the joint. General practice is to construct joints with such this stress, essentially incapable of reaching compressive loads themselves, but increasing the thickness of the joint between rigid structural members. The concept that thin metal joints are brittle under load without exceeding the elastic limit of the metal has, in fact, made possible the current monolithic metal structures. If only average loads of this metal were available it would be still possible to use shear moment values provided the loads were not at approximately 45 deg. to the structural axis and a double layer of bonds were used at 90 deg. to



FIG. 1 The four principal stages of material design development. (a) The wood grain and cross-section. (b) The wood grain and cross-section. (c) The wood grain and cross-section. (d) The wood grain and cross-section.

could be made without requiring permanent deformation. (c) The wood grain and cross-section. (d) The wood grain and cross-section.



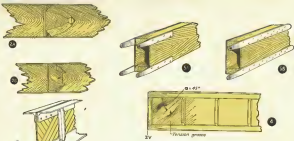


FIG. 2. A section building is required to heavily stressed joints using both plywood and corner blocks. (a) A subpanel with stiff string and cross structural ply over a wood-plated plywood construction in which corner joints are built in a 2/12 in. ratio.

FIG. 3. In the case of a flat roof carrying shear between beam bays, plywood acts partially by metal steel and is made of the same performance. (a) For purposes of strength, the metal steel is assumed to be made up of corner metal blocks using at 45 deg. in the structural steel. This construction can be made on the basis of the use of the temporary aluminum shape due to the loading rate of approximately this angle.

FIG. 4. If the joint between the plywood web in this case at 45 deg. in the shear plane it will double the shear stress in the Wagon Section field.

FIG. 5. In actual wind conditions, secondary joints are increasingly complicated and heavy duty double shear members are used, and a considerable number of bolts are needed in a single shear fitting.

each other. Designing efficiency for the moment, it is apparent that a shear web is constructed, and with proper vertical stiffness is capable of carrying load (Fig. 3).

Wood, however, due to the low tensile compressive strength perpendicular to the grain is unsuitably represented as such a series of shear stress blocks. If the stress direction is arranged at approximately 45 deg. to the shear plane it could be expected to behave in a manner similar to the metal block shear web. In the case of glass that web, (2/3 0.001), is too readily proven. In this 45 deg. range, the web or shear web blocks into wave, similar to a "Wagon" beam field (Fig. 4), and a good approximation of the web strength is obtained by similar treatment. Separating the compression zones, which buckle quickly out of action, the shear is carried by the diagonal tension zones alone.

Actual webs have usually been designed on about 60 percent of the value and the complete lack of web failure indicates it is too conservative.

For values of t/b beyond the buckling range this treatment is conservative now, there is then a maximum of non-pressure as well as known shear transmitting stress. Insufficient data are available at this time to permit their own design of such webs. Webs designed on the basis of known material only in action have provided no real failures in practice, although one quite heavy, curved web has stood up under shear stress in the vicinity of 5,000 psi.

It could be noted at this point that diagonal tension stresses in webs approximate handbook values within the expected load variation. Tensile stresses in diagonals and flanges have, on the other hand, shown a decreasing tendency to real handbooks.

Assembly Joints

Another serious difficulty in wood construction lies here the presence of joints, protruding members, not dimensions are changed, and the inevitable replacement of broken or worn parts. Sound practice in early wood assembly included the use of softened bolts bearing on the wood to transfer loads away from the wood to the metal fitting. Due to the naturally lower thickness of wood members, attachment by means of pins in single shear resulted in an unreasonably large number of joints or bolts. Provision of double shear members retained considerable complexity in the fitting design and an unreasonable weight penalty. (Fig. 5)

At best, the metal advantage in the art of joining metal to wood gave promise of overcoming these drawbacks. While they are rapidly being reduced in practice, difficulties in this area are still considerable at this time. The possibilities and values inherent in these efforts to solve joint problems give promise of new developments of materials, habits as incompatible as oil and water. The progress, even at this early stage, has earned far beyond the solution of the original problem.

Moisture Resistance

The problem of moisture resistance and dimensional stability has been attacked from two standpoints. The first has involved the use of protective coatings on finished surfaces, and the second, around the development of adequate pointing schedules. Present techniques give moisture absorption of 5 percent after prolonged immersion. The second method involves important loss of the concrete and results in very much improved moisture characteristics. Almost any degree of moisture may be achieved in the method. This impregnation procedure results in an appreciable increase in wet modulus but, for the reason here so widely abused as had originally been reported.

Gluing Joints

The desirability of wood as a structural material by the aircraft industry, was hastened by the fact that the metal gluing of wood joints was not only a simple and repeatable process. A number of industrial materials were found to give deterioration and the loss in the use of these glues effectively stopped production of metal and wood joints.

The shortcoming characteristics of these glues have been more common to the development of synthetic resins which have such high strength and good adhesion properties that a potential hazard has been removed as aircraft joints previously upon wood has been

applied to joints. The greatest risk of the aircraft was involved by the development of plastic materials, polymers, and synthetic resins. These materials had in such use an extremely low moisture absorption, apparently permanent life, high resistance to fatigue, and the ability to not least as a substitute in completing polymerization. This latter characteristic in practice the outstanding advantage of these synthetic glues were it became possible to obtain perfectly bonded joints in a matter of a few minutes whereas it had previously been necessary to maintain clamping pressure for a maximum of 4 to 6 hours.

Even in the matter of performance it was obvious that a long waiting time to obtain either heavy duplication of

young aluminum aircraft construction had required sufficient background to permit its rapid adoption. In no sense could it be said that all of the metal structural problems had been solved. Lack of adequate strength data, and a constant shrinking block, in fact, had quite recently. Production of the metal against corrosion was a serious problem (eventually, some of the early designs were discarded upon the evidence that beams with changes in joint thickness and the use of rivets in place of glue and nuts).

The progress from corruption to strength metal was hastened by the discovery that this metal structure could buckle without requiring a permanent deformation. With this point widely accepted, the department, some, sound structures were quite rigid. Treated structures were quite rigid. Treated structures were quite rigid.

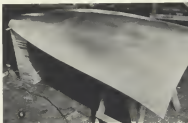


FIG. 6. A metal-plated plywood structure is complex than in completing metal construction. It is more difficult to obtain a rigid joint assembly such as the metal upon which being shear stress.

clamping pins or an assembly "gluing" joints in a production line. This "clamping" was so used as to be a joint, used in a production largely confined to nonproduction areas and places where metal joints were not required. Satisfaction. During this "clamping" from the production line became possible with a glue which could be set in a matter of minutes. Resistance to the production made possible by this adhesive has turned the entire of the structural metal material possible now two for plastic bonded materials in every field.

Transition Cycle

In the time now construction around demand has been shocked by the inherent disadvantages, the art of de-

veloping joints with these, they could not be easily separated. Careful study, however, the problem of eliminating drag due to shear resistance wrinkles as detrimental to high performance. Their compliance is not proof of their desirability or success.

Considering the materials with which we can work today, as well as the conditions of the time, it is unfortunate that the use of wood did not show in the transition experience of the aircraft industry. Design personnel entering the industry during this period have been trained chiefly in the characteristics of steel metal and ships have been trained for the production of metal aircraft. (Turn to page 334)

With the 1930s toward plywood aircraft construction gaining powerful momentum there is a vital need for fundamental design information to be disseminated. Design efforts applying to metal structures do not always apply to wood construction, in order to obtain the maximum utilization of plywood as an aircraft material, it is necessary to design specifically to plywood characteristics at its present stage of development and availability. Therefore, full consideration must be given these factors and new efforts continued.

Attention is given to wood this need through the authority of one of the country's leading authorities in the field who has probably done more to bring the art to its present stage of development than any other single individual.

RANGE OF DROP HAMMER OPERATIONS

While frequently it is assumed that the thinner the gage of sheet metal the easier it is formed by drop hammer methods, just the reverse is more often the case. The authors explain why, and offer new suggestions for more efficient utilization of drop hammers.

By CHRIS J. FREY *Research Development Corporation* and STANLEY S. KOGUT *Eastern Aircraft Production Process*

The group of photos below illustrates successive steps in shaping an aluminum receiver into a perfect circle utilizing a drop hammer. It is accomplished by a series of operations each of which forms a part of the use of the proposed circumference that finally becomes the

circle. As the blow of the hammer shapes the part by the dies the material is fed in further. Note that the rolled metal has been fed when the part is to be formed repeatedly on top of a perfect circle whose diameter is greater than the hammer bed. (After Aircraft photo.)



Drop hammer of light is typical of those used in forming large parts of aluminum and its alloys for aircraft structures. (After Aircraft photo.)

INDICATION OF THE SEVERAL also made available in drop hammer operations, and the varied relationships between them. First, it is not possible to lay down any rule of thumb by means of which it can be determined whether or not it is practical to manufacture a particular part by this method.

The following factors, however, are important in determining the feasibility of drop hammer technique for a particular job:

1. Type of material and its quality.
2. Is it too tested?
3. The required quantity or variety of size.
4. The size and weight of the hammer on which it is to be made.
5. The dimensions of the part.
6. The tolerance permissible.

Not all materials lend themselves readily to drop hammer work, particularly the type (forming) drop hammer. In general, the less ductile or the less ductile the metal and the more the yield point is low, the more it will buckle before drawing. It is most practical to try and get the best looking form drawing at all. The method of hand hammering out buckles to eliminate preliminary wrinkles really costs a fortune. Working at the drop hammer is a lot easier (in fact, when the material is too hard to hammer out, the material is too hard to hammer out). The method of hand hammering out buckles to eliminate preliminary wrinkles really costs a fortune. Working at the drop hammer is a lot easier (in fact, when the material is too hard to hammer out, the material is too hard to hammer out).

Aluminum and its alloys are the materials on which the greatest portion of aircraft drop hammer work is done. While 9000 is used for the majority of all work, the best results are obtained with 5052, 5053, 5054 and 5055 and these four are accepted as being the primary grades for drop hammer work by aircraft manufacturers.

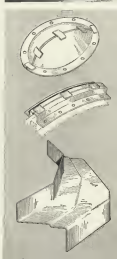
While, of course, it might appear that the thinner the gage of the metal, the less the effort necessary to shape it into the desired form, this is not the case. Many parts cannot be made in 9000 that can be made in 5052. Not too many

large parts of 9000 can be shaped and at great rate in metal in the process. From this point the tendency to provide additional strength in the gage of the material is indicated, to such an extent that the manufacture of aircraft parts by drop hammer methods has almost always been replaced by the use of the more efficient and economical methods. The deeper the draw and the more complicated the shape, the greater the tendency to wrinkle. As a general rule, it may be said that a 5052 can be drop hammer in production in some shapes. As the gage becomes heavier, more intricate shapes can be made successfully. Material as thick as 0.025 inches usually has the gage used in 9000.

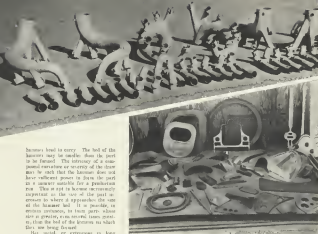
The manufacture of stainless steel parts in a drop hammer is not feasible and about ten years ago. The tendency was then to use these materials and to shape up under the drop hammer. More recently, to form stainless steel parts under the most satisfactory conditions, the use of the drop hammer is not used. The use of steel, aluminum and stainless steel is not, for the inside die, is an unusual amount and has expanded the range of the drop hammer. The use of stainless steel materials are used for the punch also.

In the old days, a simple in a sheet of steel from which a part was being made, shaped simply. Since the steel was so much harder than the lead, much more of the hammer load went to compress the work more slowly into the punch rather than out of the sheet. Nevertheless, simple parts were formed out of light gauge steel with the conventional lead punch and vice die. These methods must give way to the Kroll and the use of punch and die when either an intricate shape of a heavy gage of stainless steel must be formed. Any material having the characteristics and general characteristics of these alloys and be satisfactory.

There are various limitations which determine the actual size of a part that may be manufactured on a drop hammer. The size of the punch necessary to form a part may be sufficiently large so that its weight is too much for the



The two top sketches in panel of right are examples of perforated film and shell templates made in drop hammer shop. The bottom sketch shows a part which was made by Miller and Doug Co. in 1940 using aluminum, but was later replaced by steel in 1942 because of weight.



hammer head to carry. The head of the hammer may be smaller than the part to be formed. The intricacy of a compound curvature or severity of the draw may be such that the hammer does not have sufficient power to draw the part in a manner suitable for a production run. This is apt to become increasingly important as the size of the part increases to where it approaches the size of the hammer head. It is possible, in extreme instances, to form parts whose size is greater, even several times greater, than the head of the hammer on which they are being formed.

But small, or extraneous, or long length can be shaped into complex shapes or arcs of circles whose diameters are even as much larger than the head of the hammer as which they are formed. A fairly complex part may be manufactured by a series of operations, each of which forms a part of the arc of the projected circumference that later becomes the circle. The last stroke is fed into the hammer in degrees of length. As the blow of the hammer shapes the part to the draw, the blow is fed in further. The finished arc forms the hammer and straight material replaces it and so on. Unless the part to be formed represents a perfect circle or an arc of a perfect circle this method can not be practiced. The diameter of the part to be formed must be larger than the hammer head so the method cannot be used.

This practice is somewhat restricted by the shape of the hammer used and the shape of its parts. This method cannot be used in some small circles because the diameter of the round part must be sufficiently great to go down the head of the hammer over the top of the hammer head carrying the punch. Only the additional draw the head is relied on to strain the blank.



In planning the manufacture of circles by this method there is a tendency to forget the additional resistance caused to move the hammer head. If a part is less than half the circumference of a circle it presents an particular problem at the reverse. The part is apt to be completed before its forward portion (the first part formed) reaches a point where it may interfere with the normal action at the punch. Where the shape of the part and the arrangement of equipment permits a solid part can continue to travel in a point parallel to the four other lines perpendicular to it.

The same procedure is followed with circles with the hammer head and punch in not yet to be reversed. Much greater flexibility is encountered in straight parts.

Long, straight parts can be formed without any restriction, regardless of their length provided there is an obstruction on the punch that is larger than them. This offers an particular problem. The bar is fed in at a rate sufficient slowly in point it is shaped.

The drop hammer, in, in some a pressure is convenient but parts cannot be formed by the drop hammer method

At top, left are four circular materials made in Federal dies at Ingersoll (Open American Steel). Left, center, illustrates some of the most parts fabricated on drop hammers at Federal (Open American Steel). Left, below, are also materials formed at Ingersoll after publishing the drawings by the author and method. Shortly at right illustrates sequence of operations in forming and hammering sheet steel in the drop hammer.

random well within the limits generally allowed for sheet metal work, although with the dies commonly used, they do not measure up to the tolerances that can be held by a press. Where great accuracy is required of a drop-hammer part, the use of steel dies, or even only the use of steel inserts (called insert type) will usually meet stringent requirements.

In comparison with other types of forming machinery and methods, the drop hammer is an exceedingly mechanical machine to use even the die strokes represent only a rapid movement. They can be resisted and moved. Presently where only a few pieces of a particular part are needed, does the drop hammer come into its own. Where these parts need considerable drawings, the balance is even more in favor of a drop hammer. Super hammer moves have a tendency to eliminate the stress set up in metal, the drop hammer method is ideal where a condition of spring back exists. It has no difficulty with deep draws and can make parts without difficulty where the metal are not too much as the normal too sharp. Wing type, forgings, couplings and some other are excellent examples of the type of part under the range of the drop hammer.

Marking

Certain parts can be formed on a drop hammer and then formed by a second operation. Very often the possibility of forming by a drop hammer is overlooked. The type of die and a slightly different form, an ordinary operation in that it must have a cutting edge along the line where the form is to be made. In most cases, the metal out of which the die is not well have the necessary qualities for cutting. This edge must be placed in such a way that the motion of the first forming operation is not affected. That can be done without great difficulty. The first operation may consist of more than one blow of the hammer, and in need for forming alone. The sheet is not faced against the cutting edge at all during the first operation, and the shape of the punch will render its managing the most satisfactory.

The punch is then raised so that it is parallel to the surface to finish the part and the placing of blades of the hammer on the sheet over the cutting edge enables the operator to blank the part

by the pressure applied to the rubber in the next few blows of the hammer. The use of a rubber blanket for this purpose is very often satisfactory—some authorities in the industry notwithstanding. The face of the hammer blows distributed over the area of a single piece of rubber, having several times the surface area of any other blank, cannot possibly be as effective as the use of two blanks correctly placed. The dies must be locked.

Finally, when making punches, dies should like a die. The blow of the hammer creates pressure on the rubber causing it to flow in the direction of least resistance. This is bound to be in the direction of the punch, or not forced by the die but in this way the part is forced against the cutting edge.

Cutting in this manner is much faster than using a true template, and a hand saw. The first blow of the hammer gives during the blanking process also means almost instant. A sheet here is left by this operation that can be removed easily by hand.

This type of shear can only be used on fairly flat work. For forming a deep draw part a surface template is used from a piece of calibrated sheet. After the part is marked it is trimmed on a hand saw.

For parts with compound curves, such as a section of fanlight rim or a steel panel, forming punches may be used around the edge of the die to great advantage (See sketches on page 122). These definitely locate the metal and keep the parts from springing back or warping around. In this way the blow are struck in the same place each time and there is no distortion. This is a most important modification of the usual method, generally no one method of building the part as given.

Trim and Drill Templates

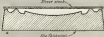
Skills for measuring and drilling templates are strapped from patterns cast metal in the same dies as the parts. In order that the patterned template, may fit over the parts to be replicated, and the shape of the punch when it comes out of the die. The two halves are placed over a finished part and checked for accuracy and relationship, after which they are fastened together by means of blocks of the template may be fixed over other parts. (Turn to page 109)

First Operation—Forming

Form (Before)



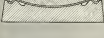
After stroke



Die (Before)



Forming Blow



Form (After)



Form (After)



Form (After)



Form (After)



Form (After)



The last article of the series in which the author concludes his discussion of beam and urges a new approach to the problems of designing and building

THE FUTURE OF WATER-BASED PLANES . . . VI



waterplanes equal in performance to landplanes. He maintains that such results are inevitable; their achievement first in the United States is essential to maintenance of a leading place in aeronautical development.

By CAPT. FRANK T. COURTNEY

PROBABLY THE MOST government test that comes out of an open national study of the hydrodynamic of modern hulls is that beam has been allowed to become the primary factor in hydrodynamic study instead of beam, as it should be, a secondary factor with pleasing rise as the primary factor. As a result we have run into a state of affairs where airplane hydrodynamic have taken on an air of immense recognition and definitely show, as first, hydrodynamic is a matter of extreme simplicity, at least as compared with aerodynamics.

In hydrodynamic we have our surface only—the lower surface—to consider

The surface need be beautifully flat, or at least as over is being flat that we have only a small range of variation to worry about. There are no problems of section, camber or circulation. The only basic variables are those of plan form, cross-section and depth, and the practical range of these is relatively small. There will, of course, always be some extraordinary complications but, in general, it would seem that a quite small range of tests would give us all the basic hydrodynamic data we should ever need.

The cause of the present situation appears to be that we have systematically allowed our hydrodynamic to be gov-

erned by our hydrodynamic and hence by the transient stage—known as the "beam"—from static buoyancy to hydrodynamic support. This, in fact, might have seemed inevitable since here we are going to reach the hydrodynamic stage if we are not floating properly to start with!

However, the fact is that our hull dimensions are based on our flotation requirements and not our flight requirements, and the net result is that we have a beam which is far greater than our flying requirements and which leads to our steep, airworthy, desirable and problems of stability, and to conditions of metal loss which largely provide our unpleasant leeway curve.

I can see no reason why a new line of thought cannot be successfully adopted, one whereby the dimensions of our hull are based, as in a landplane, on flight requirements. Our hydrodynamic area will then be the result of the length and breadth available, and the chances are that then we will be plenty to play with. This let us add buoyancy which, since it must add to dimensions, must obviously be undesirable. This must involve problems of maintenance and weight, which are likely to be much smaller than those which have been overcome in retractable land gear. It will also involve serious water drag problems in which I see nothing unappealing.

There is nothing very startling about such a proposal, it merely suggests dealing separately with our flight and our flotation requirements. However, it would naturally be subjected to all the common attitudes to new schemes.

When you look at the beautiful streamline shape of the modern landplane section you might suppose that a hull which cannot employ such a "perfect streamline" must necessarily have considerably less resistance. Actually the "perfect streamline" is largely an illusion. It would be what it appears to be if, that is, it had no wings. But the wings produce a curved stream which runs well ahead of them and fails well behind. So your streamlines aren't what it seems.

In military aircraft such matters as gun barrels, radio gear, and mounted tank requirements provide tailwakes which only detract any cleanup in perfect fuselage streamlining. This is pre-

pare that means, as I have said, I do not propose to put forward specific methods of achieving these results until at least elementary test data are available on which comparison can be based.

Aerodynamic of Hulls

It is possible to imagine, or even to produce, a hull of conventional streamline form in which the bottom unfolds to provide the hydrodynamic characteristics needed, but it is hardly likely to be a practical proposition. It comes at present that our hull is likely, in any case, to have to fly with the flat, or nearly flat, hydrodynamic surface with its discontinuities—such as chines, in some form—which water performance demands. Hence, as I said earlier, the waterplane shape certainly may cause such aerodynamic penalty for one of the water, a penalty to be compensated by lead gear weight saving.

When you look at the beautiful streamline shape of the modern landplane section you might suppose that a hull which cannot employ such a "perfect streamline" must necessarily have considerably less resistance. Actually the "perfect streamline" is largely an illusion. It would be what it appears to be if, that is, it had no wings. But the wings produce a curved stream which runs well ahead of them and fails well behind. So your streamlines aren't what it seems.

In military aircraft such matters as gun barrels, radio gear, and mounted tank requirements provide tailwakes which only detract any cleanup in perfect fuselage streamlining. This is pre-

sumably why the drag coefficients of some modern boat hulls compare not too unfavorably with those of corresponding landplane fuselages.

Another factor is the fact that drag is affected not only by an aerodynamic in effect but also by its location. For example, rudders based on the forward section of a wing cause more loss than similar rudders located farther aft, partly because the local air speed around the forward rudders is greater and partly because the turbulence they cause is spread backwards over the wing. Thus the drag of steps and chines—or anything which may take their place in future hydrodynamic developments—must be considered with respect to their location as well as to their dimensions and form, and an overstatement about the drag is likely to provide higher drag than a similar one below the wing. So wind-tunnel tests of body shapes without wings are not likely to be very accurate.

For these reasons I believe that the drag of future hull forms will be somewhat closer than that of landplane fuselages but not very much so, since the water hydrodynamic disadvantages to air flow will be considerably less than they are now and will be low and aft. For these reasons also I believe, as previously mentioned, that the smallest ones, such as single seat lighters, will present the greatest difficulty in these respects. In general, then, bodies are so small that hydrodynamic resistance are likely to be proportionately large and their effect may be obvious.

(To be continued)

LEFT: Water-based planes can have hulls of beautiful aerodynamic shape even though their hulls are not uniform in cross-section. The hulls of the "perfect streamline" must necessarily have considerably less resistance. Actually the "perfect streamline" is largely an illusion. It would be what it appears to be if, that is, it had no wings. But the wings produce a curved stream which runs well ahead of them and fails well behind. So your streamlines aren't what it seems.

RIGHT: The study of landing planes on the water involves three subjects: hull hydrodynamic stability and control of the ship, and water drag of the water exposed with rudders and keel-mounted components. Capt. Courtney believes "depth of water" is as important to hulls as air has been given little study.



FIG. 1. More than 1,600 members of the SAE, aircraft industry engineers registered for the Oct. 1, 2, and 3 meeting at the Wilshire Hotel, Los Angeles. In this photo Col. J. H. Joubert (back to camera) president of the Associated Chamber of Commerce of America has just stated the theme of the registration week.

FIG. 2. The Association Bureau of the SAE held such Committee has assembled before it gets down to work. Building them 1 to 4, these present were: Harold Adams Douglas Aircraft Co., Inc.; J. B. Building SAE and representatives; B. C. Building Lockheed Aircraft Corp.; Arthur H. Wright New England Corp.; C. S. Building War Production Board; L. D. Building, Lockheed Aircraft Corp.; and John A. C. Warner, general manager of SAE.

FIG. 3. President A. W. Herrington (right) and Max Sheff, Pope Aircraft Corp., engaged last after President Herrington had announced that Mr. Sheff is the theme of the National Aircraft Production Meeting at the Wilshire Hotel, Los Angeles. He said president of SAE and had called the members in the afternoon to be representative to the topic Friday night general meeting audience.

FIG. 4. Attendance to the program for the general session, Oct. 2, suggested in an informal conference just before the meeting was called to order by Chairman A. T. Colwell, meeting from 1 to 4 are: Tye M. Lett, Jr., Alcoa Division of General Motors with the AFM in Charge; Col. J. H. Joubert, American Chamber of Commerce, Chairman; Chairman, President A. W. Herrington, Max Sheff, Pope Aircraft Corp.; and Thomas Wolfe, Western Air Lines representing the Air Transport Association of America. Their speeches related current activities of United States military aircraft.

SAE HOLDS AIRCRAFT PRODUCTION MEETING



FIG. 5. The Adel Products Products Corp. stands are built by two Adel employees in their spare time. Father could raise and lower the model plane's heading gear by manipulating the Adel controls it demonstrated. Other products of the company were on view at right and left.

FIG. 6. A "project" for membership in the SAE (shown to C. F. Lane of the society's Los Angeles office) is to discuss membership and qualifications. Background of the SAE booth is liberally decorated with literature and photos.

National Aircraft Production Meeting of the Society of Automotive Engineers, meeting in Los Angeles October 1-3, draws 1,600 engineers for technical sessions. Joubert, Herrington assert U. S. planes superior.

HOW TO MAKE 1945 United States aircraft better and manufacture them quicker was the principal theme of the National Aircraft Production Meeting at Los Angeles, Oct. 1, 2, and 3. Conducted by the Society of Automotive Engineers, the three-day meeting was the largest war effort exhibit, devoted to technical matters, and was attended by more than 1,600 members of the SAE.

Although currently under fire as inferior to English, German and Japanese planes, the three-day meeting was the largest war effort exhibit, devoted to technical matters, and was attended by more than 1,600 members of the SAE. Although currently under fire as inferior to English, German and Japanese planes, the three-day meeting was the largest war effort exhibit, devoted to technical matters, and was attended by more than 1,600 members of the SAE.

Col. Joubert deplored the current state of criticism of United States aircraft as reflected in Soviet and German propaganda. He quoted "box scores" of our engagements which he said proved the excellence of both United States aircraft and their pilots, and recommended the SAE for the standardization pro-

cesses, Thomas Wolfe, of Western Air Lines, Inc., representing the Air Transport Association of America, and Tye M. Lett, Jr., Alcoa Division of General Motors and recently on the AFM in Charge, presented new data, report on the fighting excellence of United States aircraft and personnel.

A. T. Colwell, vice-president of Thompson Aircraft Products Co., and chairman, opened the meeting with a short statement of all four of the scheduled speakers. It was that United States aircraft are the best in the world, the aircraft with which they are equipped excel those of the enemy, that quality is being steadily improved, production is meeting its goals, and the latest models are setting in such quantities, at costs all over the world, they have already topped the balance of our power to the Allied Nations' side on all but two fronts, land and sea.

Col. Joubert deplored the current state of criticism of United States aircraft as reflected in Soviet and German propaganda. He quoted "box scores" of our engagements which he said proved the excellence of both United States aircraft and their pilots, and recommended the SAE for the standardization pro-

cesses. Thomas Wolfe, of Western Air Lines, Inc., representing the Air Transport Association of America, and Tye M. Lett, Jr., Alcoa Division of General Motors and recently on the AFM in Charge, presented new data, report on the fighting excellence of United States aircraft and personnel.

President Herrington of SAE, in his address, referred again to the same theme and urged his audience to read and preserve the editorial in the September issue of *Aircraft* (pages 88 and 89). "The old beyond claim," Herrington said, "James H. McGraw, Jr., president of the McGraw-Hill Publishing Company, has set down your 'box score' to persuade him, as a second addition, which appeared in *Aircraft*. As most of you are familiar with the contents of your own trade papers I will not take the time to repeat it here. It is a great and fitting tribute to a job well done and should be in your company's files for future reference."

Proof that much remained to be said for superior United States aircraft will be far better and more detailed in the months ahead. In the meantime, the standardization work involved by the audience, covered in the technical papers given during the meeting. As in the custom of SAE's members of 1917-1920, women were

devoted to such subjects as Aircraft Engines, Flight Training, Airframe Production Techniques, Aircraft Welding, and Aircraft Materials. Papers were about problems associated with these various fields.

Although restricted by the limitations imposed by military secrecy, all but two of the originally scheduled papers were presented. Thus, two, one on Aircraft Engine Power Controls and one on Flight Training Aircraft Quality, were cancelled at the request of the federal government. No documents were presented after the reading of papers, due to the needs of the military, to prevent any internal leaks of information. The interest of the discussion, which were cancelled after the program had been completed, the time allotted to them was used to present industrial movie films supplied by the Wright Aeronautical Corp., Bell Aircraft Corp., and the Benthon-Barnett Propeller Division of United Aircraft Corp.

The 25 papers and 4 speeches fall into four categories: 1.—Research reports, properties of new materials, improved methods and processes, and data concerning aircraft design and engines. Three of the four speeches reflected the current studies upon United States aircraft with data of an over-all nature. The fourth, by Mr. Left, was a more or less detailed "report from the front" that gave out the conditions of the other three speakers, and did it with specific outside assistance. Mr. Left touched on the "Flying Experts" flying around only at backwash in the main portion of his talk, which was devoted to the problems encountered and solved by the AVG ground crew.

Three technical papers were devoted to research studies. Three others covered the type of subject of new materials. And four papers provided information on new methods, and new processes. Through the latter one the "field tests" theme, and through the materials

theme, one delivered Friday and the other two in the closing session on Saturday morning, demonstrated information that is currently sought throughout the aircraft industry. One discussed the problems involved in substituting low-temperature for critical materials, and the other two gave detailed accounts of aircraft uses so far developed for two prominent wood plastics.

The paper, on low-Critical Materials for Airframe Production, L. D. Boehm, of Lockheed Aircraft Corp., outlined that a better title would be Low-Critical in place of Non-Critical because previously all materials used in aircraft are more or less critical. His use of the word critical differed from what is meant in its ordinary use, he explained, and not advance adoption of any single substance, but instead discussed the problems involved in wood, steel, metal and plywood, meeting material substitution and plastic, rubber elements and substitutes for economy and plating and finishing materials. He concluded by stating that aircraft engineers must realize their responsibility in this area and that the successful use of a substitute will help pay large dividends by its contribution to the war effort.

Wood Plastics in Mass Production of Aircraft, a paper prepared by Corbin S. Ince and Harold J. Black, both formerly of the Pioneer Manufacturing Co., and delivered by Mr. Ince, reviewed the history of use of wood in aircraft and discussed new and available possible by development of new materials and new methods.

The paper called attention to neglect of the technique of aircraft woodworking from 1918 to 1940, noted in some available plans places, and to the huge and untold opportunity of so many still existing aircraft woodworking experts. It pointed out that there is a difference between producing wood parts for 190 airplanes and producing the same parts

for 10,000 airplanes. To produce in large quantities it is just as important to have proper tooling for wood as it is for metal. It is just as important to have good production designs, just as important to have simple and satisfactory production processes. Unfortunately, he said, the same with which wood can be worked is too often combined with a laissez-faire attitude.

The paper's conclusion was that wood is a satisfactory aircraft material when suitable reinforced by plastic substance, recent techniques in handling it serve to reduce its place in non-permanent aircraft, and that wood-plastic should be looked upon as a fundamental structural material rather than as a second-best substitute.

C. H. Hakeby of the Plycraft Design Co., Eagle Paper Co., delivered the closing paper of the convention. His talk was New Applications of Plycraft in the Aircraft Industry. It listed use of Plycraft as storage bin, gun, shield, shield, dome, fuselage, fuselage, pulley, tank, hull, hull, and various parts. It concluded with the prediction that this material, which has been used in a substitute, will become a permanent material for certain use in the manufacture of aircraft.

His paper covered new methods and processes. One by W. T. Decker of Douglas Aircraft Co., Inc., described equipment, largely developed by that company, for revealing light test data economically. It concluded with the prediction of greater uniformity, accuracy, more durability and reliability of measuring machines, and increased recording speeds, and that with these advances will come advances in the aircraft arts.

Technical Developments in High Production Sheet Metal Forming, a paper prepared by W. Schneider and T. H. Hurdell of the Lockheed Aircraft Corp., was delivered by Mr. Schneider. Joseph Kirtmann and Gold Pressing of Alcoa-

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FIG. 7. Hakeby was the chief speaker at the American Bush Corp. in its closed shop. FIG. 8. A. Hakeby, one of the members of the American Bush Corp. in its closed shop. FIG. 9. A. Hakeby, one of the members of the American Bush Corp. in its closed shop.

FIG. 10. Hakeby was the chief speaker at the American Bush Corp. in its closed shop. FIG. 11. A. Hakeby, one of the members of the American Bush Corp. in its closed shop. FIG. 12. A. Hakeby, one of the members of the American Bush Corp. in its closed shop.

FIG. 13. Hakeby was the chief speaker at the American Bush Corp. in its closed shop. FIG. 14. A. Hakeby, one of the members of the American Bush Corp. in its closed shop. FIG. 15. A. Hakeby, one of the members of the American Bush Corp. in its closed shop.

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FIG. 19. Hakeby was the chief speaker at the American Bush Corp. in its closed shop. FIG. 20. A. Hakeby, one of the members of the American Bush Corp. in its closed shop. FIG. 21. A. Hakeby, one of the members of the American Bush Corp. in its closed shop.



Cutting through "Atlantic soup"

DURING the past year, 595 out of every 1,000 American-built bombers and flying boats have ferried the Atlantic safely—a loss rate of only one-half of one per cent!

This remarkable performance record has been achieved in spite of the treacherous storms and heavy fogs of the North Atlantic that

make instrument flying a common necessity. Every day our ferry crews are placing their confidence in Kollsman Precision Instruments, for thousands of these planes are Kollsman-equipped to a high degree.

We're proud of the part Kollsman instruments play helping them cut through "Atlantic soup."

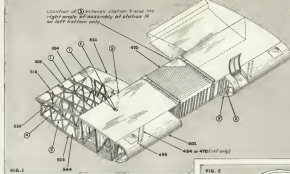


FIG. 1 Assembly drawings prepared in one of the many sections of Flightways tool engineering department, have proved highly effective in solving new problems through assembly steps. Typical is the sequence assembly shown in Fig. 1. The circled numbers list the parts required the other numbers list the parts to be assembled. An accompanying sheet lists the assembly procedure to be followed, in this case the work being simplified in that only 11 steps are required. **FIG. 2** Two simple examples from their assembly drawings and assembly procedure situations as shown in Fig. 2. Also the drawing the parts required and the assembly procedure are all in one sheet.



Tool Design Gains Importance

Necessity for increased use of semi-skilled labor puts added burden on tools and swift production essential to maintain steady output of finished parts

By **JOHN J. SCHEPPE**
Chief Tool Engineer, Flightways, Inc.

THE WORK of the tool designer tends to increase at a faster rate even than that of aircraft production. This is due in part to the fact that new and modified weapons are economically being brought into the field—often back of shell metal, so much as possible, is made up by tools. It is also due in part to the fact that designs, even on parts of aircraft, are seldom frozen for any length of time.

Now, in the vast majority of cases, speed is vital in getting the tools into the hands of workers, tool design and production must be expedient as well as

the parts and aircraft assembly have themselves. Thus, as the case of a common wing bulk piece and subassembling work, changes are so many and frequent that the work becomes longer and longer, even though it may not appear so. It is a fact that the engineering work per unit or part is heavier.

At Flightways, for example, the tool engineering department has one different section, each with well designed lines of operation.

Following the release of blueprints by the Production Engineering Division the first step in tooling up is held on an early surface, for instance, is initiated by the tool planning department. Here the tool planning board, with drawing with a process engineer and representa-

tives of both tool design and production departments, make a careful study of each of the blueprints. This phase of the process is known as the breakdown, where each of the many parts will be listed in subassemblies, and all the tools necessary to fabricate the parts are recorded. The importance of this step cannot be over-emphasized, since it is obvious that the speed with which production can be moved along depends largely upon the efficiency of the tooling and the ease with which parts can be assembled.

As the tool engineers record the various tools and fixturing which will be required, the process engineer outlines the actual methods of fabrication selected. (Turn to page 260)

Maybe he's *your* boy



It seems only yesterday he was a poky schoolboy, all hands and feet and rosy cheeks.

Even then you worried a little, parent-like, about how fast he drove his battered jalopy.

Now he's flying—or soon will be—the deadliest weapon in the air, a sleek 400-mile-per-hour fighter.

Or perhaps his battle station is the bombardier's "huber chair," or the tail gunner's "goldfish bowl" in a giant bomber, or at the controls of a U-boat-busting barge.

Whatever his duty, more than your fears and your prayers fly with him—all your hopes, all your dreams for him and for your country side in that aircraft, too.

What cost of effort or real or self-denial is too great—if it will give him the finest plane, the latest equipment in the air?

We feel the same way about it here at Goodyear Aircraft. Many of our men and women have sons, or brothers, or husbands, in the air forces, too.

Absent beyond this there is the sober knowledge, dear now to all Americans, that our cherished liberty, our standard of living cannot be secure

again until this nation wins command of the air—and it is these boys who must win it for us.

It is for them, your lad and ours, that Goodyear assemblers—welders and riveters, precision and fitters, engine and accessories together—are striving with all the skill and ingenuity of long aeronautical experience to help build the safest, sturdiest airplanes and airships modern engineering can create.

It is to give them mastery of the skies that we are working in round-the-clock shifts, seven days a week, to produce our full share of the airplane subassemblies—wings, tails, control surfaces, cabin seats, wheels, brakes and other parts—for the 60,000 airplanes America must have this year.

In this we are working with and for the manufacturers of some of America's most famous battleplanes, both fighters and bombers, that are proving their superiority on all fronts.

If your boy is flying out of them, you can be sure his craft is as sound and sturdy as accents of great American industries cooperating together can make it.

For these boys, yours and ours, are the hope of America, the guardians of the greatest heritage ever given to any people. They will not fail us, nor we them.

★ AMERICA MUST
BE FIRST IN THE AIR
★ Values and spirit America is the
most powerful nation in the
world, our values, our freedom,
and our standard of living
will not again be what they
have been in the past.

—Franklin D. Roosevelt



HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRPLANE INDUSTRY

1. By building parts to meet "fastest" requirements.
2. By designing parts for all types of planes.
3. By manufacturing parts for mass production.
4. By searching our research facilities to solve the solution of any design or construction problem.



GOOD YEAR
AIRCRAFT



Welding torch	Check for air leaks, especially at the handle and the hose connections. Check for air leaks at the hose connections. Check for air leaks at the hose connections.	Check for air leaks at the handle and the hose connections. Check for air leaks at the hose connections. Check for air leaks at the hose connections.
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to avoid be caused by, and proper at welding. Never use any other kind of in every time. The "M" sign or number 90 welder's union the container is in fact intended, when the job may be started with a "normal" state and finished with "a normal" state.

For the operation, press the state or welder's union the container with moderate pressure with the main pressure, and move it back and forth across the container's surface. Do not put in more in contact with the parts. Keep the dust out of the machine.

If the container is very rough as indicated by pronounced up and down vibrations of the brushes, the structure should be taken out and the container turned down in a job. When this is done, it is usually necessary also to set back the mechanism between the container and the brushes. If the container is found to be dirty when the generator is stopped, it should be wiped clean with a piece of canvas or other cloth that is free from dirt.

After put on the container Proper selection of brushes gives the generator all the information required to prevent excessive wear and to build up a good smooth-running plant surface on the copper. The selection of all results in the development of a high resistance film which may cause more heating and rough brush action. The oil will also have a detrimental effect on the internal parts of the generator.

Transformers

The use of welding transformers of a welder require a measure of maintenance, but the fact that they are allowed to remain in operation. On the other hand, they should be cleaned and lubricated when they are used. Warnings should be taken out at least once a year in very clean condition, and more often at busy periods. At the time of the periodic cleaning, all connections and supports should be checked and tightened. Manual current adjusting mechanisms should be lubricated often enough to prevent stalling operation of the handwheel or crank, making sure that a fairly high working-point pressure is uniformly distributed over the full length of screws and guides. Go no for opened materials, lubrication at every frequent intervals may be required, as evidenced by slowing down of the motor or noise from the gears. The point should be checked at least three times a year, and more often if experience judging it.

Abuses

While most welding equipment is designed to stand up under normal, adverse operating conditions, some not (Turn to page 208)

10-MINUTE ASSEMBLY JOB CUT TO 2½ MINUTES



The Denison Hyd-Glue is a new machine designed to do a job that formerly required two men. The assembly and disassembly of anyone require less than 10 minutes.

Welded plants all over the country are getting help like this from Denison Hyd-Glue. And the explanation is only one example of the wide flexibility and ever increasing range of Hyd-Glue. In this case, it eliminates the need for taking time and effort and saves valuable time and labor.

The completed is linked in the future in three sections with the center section held rigidly in place and the two end sections remaining movable. Operation of the adjuster valve during the hydraulic fluid is either right or left hand turn. Movement of the new operating lever moves the sliding arm of the adjuster, and according to the position of the adjuster and internal parts of the check. The operator then slides the adjuster valve applying pressure in the opposite end and repeating the operation to the other end of the conduct.

This is all hydraulic in its best — operating was production of control parts, in almost every industry Denison Hyd-Glue is equipped with efficient working materials, eliminating expensive, doing jobs better and better at lower cost.

To find out where Denison Hyd-Glue can help you visit your Denison representative or write directly to the factory. The Denison Engineering Company, 1166 Dulles Road, Ottumwa, Iowa.



Helpful Literature!

A 28 page booklet describing Denison standard and special Hyd-Glue systems and their applications is available free. Contains complete and complete 11 page section of valuable engineering data and tables. Write for your copy today! Or get between letter head plates.



SPECIFICATIONS

Maximum Stroke each cylinder	6"
Maximum Internal pressure	25"
Size of maximum bolt	1 1/2"
Depth of flange	7 1/2"
Size center of hole	5"
Cylinder diameter	3"
Flange diameter	11 1/2"





Fabricating Plane Parts From PAPER

Saving of heavy machines as well as strategic materials found possible by plastic banded paper said to give smoother surfaces

MANY of the secondary and some primary aircraft structures can now be successfully fabricated by use of laminated paper plastic instead of the conventional aluminum. The plastic-formaldehyde impregnated paper used in the process is made from special pulp, a material available in almost unlimited quantities.

The McDaniel Aircraft Corporation, working in cooperation with a large

plastic manufacturer, a paper stock-forming company and the Pulp and Paper Section of the Forest Products Laboratory, U. S. Department of Agriculture, has produced, for example, a paper plastic wing tip composed of but 12 parts compared to 86 parts for the same tip constructed of aluminum. Tests have shown this tip to be both stronger and lighter than its metal contemporary.

In contrast to large equipment used in most plants work now being done in the industry, it is possible to use relatively light equipment for production with the new process, since molding is done at 225 lb per sq. in. pressure, compared with 1,800 to 3,000 lb normally required. Further savings have been made possible since McDaniel now fabricates this in place of more expensive steel dies.



FIG 1. Impregnated paper to be made into aircraft parts across the factory in spreading rolls. The paper is made from a special pulp available in almost unlimited quantities.

FIG 2. Here the paper is cut to pattern size for an experimental wing tip. Five or six sheets of paper in the sheet form constitute the necessary thickness for forming into the tip.

In a production operation machine's current would be made in a single operation by large cutting machines. FIG 3. The wing tip also comes from the press. Molding is done at 225 lb pressure compared with 1,800 to 3,000 lb pressure used in most other processes. The use of lighter equipment helps save vastly needed heavy machinery. Also, fabrics that resist air stress exposure and fire can be used. FIG 4. A laminated paper plastic experimental wing tip under a static load of 2,000 lb. 140 percent of design breaking load of a comparable aluminum tip. Unlike the hard tip some tips showed slight failure but was not destroyed. FIG 5. McDaniel Aircraft Corporation Engineers Earl Kappeler (left) and Charles Monahan (right), Chicago, show beginning of the process in the form of impregnated paper and the end of the process in the finished wing tip. Advantages of the laminated paper plastic tip are smooth surface not needing finishing and coping around the mold and wood; greater resistance to aluminum and denting and adaptability to double curvature forms.



The B.F. Goodrich Airplane of the month NORTH AMERICAN B-25

JAPAN WON'T FORGET its visit from the B-25's. You can be sure of that! And these fighter-bomber bombers will strike again . . . whenever the Army commands. That's a promise made by the manufacturer, North American Aviation. Leading military planes are supplied with B. F. Goodrich products . . . De-Icers, so they can fight the enemy and forget the weather . . . Silvercrown Tires and

Expander Tube brakes for greater safety . . . and other important rubber and synthetic parts. This month, B. F. Goodrich salutes North American and nominates the B-25 Bomber as Plane of the Month.



B.F. GOODRICH RUBBER RESEARCH FOR THE

Aviation industry



De-Icer slide films are valuable aids in visual training programs

TO HELP in the task of passing the "know-how" about De-Icers along to your personnel, B. F. Goodrich offers a group of four reading slide films. These four 35-mm. films, together with booklet editions of each film, are available for Army and Navy training centers, schools, airlines and aircraft manufacturers.

"The Development of the De-Icer" gives a brief explanation of the causes and conditions of aircraft icing, what De-Icers are and how they operate. This short film shows the need for complete protection from ice.

"De-Icer Servicing and Installation" shows the various steps in removing, repairing, storing and

re-installing De-Icers. Maintenance personnel will find the assurance this film gives when working on De-Icers.

"De-Icer Operation" contains specific information for pilots, and other flight personnel on matters concerning De-Icer operation. This film is now in preparation.

"De-Icer and Design" discusses in detail the various types of De-Icers, methods of installation, attachment devices and the air supply system. It will assist aircraft production personnel—designers and engineers—when they incorporate B. F. Goodrich De-Icers in future planes.

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We have prepared pocket-sized booklet editions of the slide films. The booklets contain all of the individual pictures and accompanying reading text from the films. If you are now using the films as part of a regular instruction course, you will appreciate the opportunities these pocket-size booklets afford in further establishing De-Icer principles. We suggest you distribute copies of the booklet edition of the films to members of the audience for individual study.

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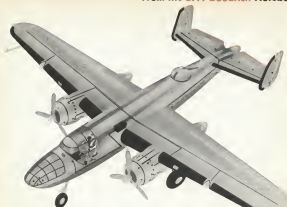
Both the films and booklets are available without cost to qualified persons in the aeronautical industry who send in their requests on a company letterhead. When re-

questing the films, please tell us how many copies of the booklets you can use to advantage. Write to the B. F. Goodrich Company, Department 7193, Akron, Ohio.

In war or peace

B.F. Goodrich

FIRST IN RUBBER



THIS DRAWING SHOWS where the B. F. Goodrich products are on a typical aircraft fuselage. You will be able to distinguish everything from propellers to the DeLorans on the leading edge of the wings. In addition, bullet-resistant fuel tanks, carefully concealed for military reasons, are located in the plane.



B. F. GOODRICH SILVERTOWN TIRES help a modern pilot achieve safer, smoother landings—thus building his confidence. You'll find tires bearing the famous name, Silvertown, on planes of all sizes, from primary trainers to huge 4-engine bombers, and on commercial planes and private planes as well. They help unhesitatingly to "Keep 'Em Flying!"

B.F. GOODRICH
General Offices
Akron, Ohio

THE PROCESS OF FORMING acrylic sheets is well known, simply stated, use the heating of the plastic and it is plastic enough to easily form into the desired shape, holding it in position in this form, and allowing it to cool and set. There are, however, various technical problems that make the process somewhat more involved than it may appear.

The possibility of forming sheets from a plastic sheet, for example, is rather good, and careful control is necessary. These sheets from may appear for various reasons. Some of these are:

1. If the acrylic sheet is not hot enough to form readily.
2. If crosshatching were standing on one part of the sheet (the warping), without suitable guidance of the stretching effect between the two parts.
3. If the cooling of the plastic sheet is not uniform.

The last cause of strain is the one that can be better controlled with plastic form blocks than with most other materials. The type of form blocks used is rough-sawn in connection with this discussion.

The simplest type is the form block, with only leading lines to be observed, and with centers of such large radius that it is not even necessary to drop the acrylic sheet in position while it is being heated (Fig. 1). The second type is a slotted die with sharp corners, requiring a clamp to hold the plastic in place during the stretching process (Fig. 2). The third type involves the use of a rag clamp around the edge of the sheet and the formation of that sheet by pressure (Fig. 3).

At the present time, these dies are made of various materials, a large part of them being of hardwood, some being made of metal, and some of plastic or bakelite. Each of these materials has its own particular advantages and disadvantages.

The plastic of pure die can be made much more rigid than any of the others, because of the ease of forming and the ease of handling this material. It is possible to make a pattern partly of plastic and partly of modeling clay and from this to make a mold in which the plastic of pure die can be cast. This is the simplest means of obtaining the mold in some cases. In others it is easier to cast plastic of pure die in shape and set it down to make the desired die. The area of obtaining a die of this sort makes it the largest plastic of materials for the dies in which the plastic of pure die can be used. However, if a good many parts are to be formed on the die, the plastic of pure die

Fabricating Plastic Dies for Acrylate Sheets

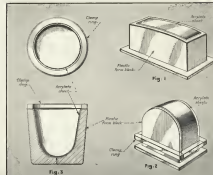
Savings in time and money possible through use of cast phenolic plastics; heat transfer qualities held superior to metal dies.

By KENTON J. LEEG, *Plastics Division, Baker Oil Tools, Inc.*

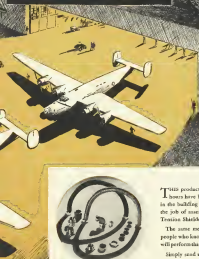
water rather rapidly and becomes chaffy or cracks on the surface. Therefore, if many parts are to be made, the plastic of pure die is not the best material to use, because of the large number of the replacements necessary to maintain the true and because of the time lost during replacements. The reason for this is that the use of plastic of pure die is that the hardness of the plastic of pure die depends on the degree of hydration of the material, and the heat absorbed from the acrylic sheet causes evaporation of the water, thereby causing the material to become soft.

Of course the fabrication of metal dies is the simplest, in most cases, of any

type of material that is used. The amount of hard work necessary to fabricate the metal die is well known and is a definite handicap to the use of metal except where a very large number of parts are to be formed. The metal die, on the other hand, is mechanically stable and is considerably more resistant to the various forces which may cause the breakdown of the die. In addition to the high cost of fabricating metal dies, there is an additional disadvantage in the use of metal for this purpose. When acrylic sheets are formed on metal dies, at the start of a run the die is cold, and, since it is a good conductor of heat, the die itself absorbs a



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In Canada: American Flexible Hose Ltd., New Toronto, Ontario

American Metal Hose

ing-part of the heat from the acrylic sheet. The absorption of heat is often serious due to variations in thickness of the metal die and common variations in the cooling rates of the plastic, thereby developing stress lines in the finished parts. As the heat progresses, the metal die continues to lose heat and it causes up to approximately the temperature of the acrylic sheet as it is applied to the die. From this point on the die acts as a reservoir for the heat from the plastic, absorbing a large part of the heat immediately upon application of the plastic sheet and returning it to the plastic sheet during the cooling process, which slows the freezing cycle for the material and consequently decreases production rates.

The usual die is the most satisfactory for most purposes because it has a rather low heat transfer. This allows the heat to be lost from the acrylic sheet to the air instead of to the die, and allows for increased cooling rates. Whether the use is a short run or a long run on that particular die shows the cooling rates are consistent and uniform, the plastic pieces that are formed on a usual die are much less likely to have stresses developed. The more difficulty with the usual die is caused by the fact that they are made of blocks of steel placed together. Occasionally, when the block is used in rapid production for a long run, the glue is forced to such a point that it will lift above the surface of the die and produce a thin line of material with a different coefficient of heat transfer from that of the rest of the block. This causes a variation in

cooling rate in the sheet at this point, and produces stress lines in the finished product. While this may be corrected by supporting the blocks often and avoiding formation of such glue lines, it is difficult to be sure this will always be done. In addition to this, the preparation of the usual die is simply a time-consuming operation. This means that the die is relatively expensive, and takes quite a little time to produce, which may cause a bottleneck in production.

Some recent tests have been run on the technique of acrylic sheets using Baker Cast Phenolic plastic dies. This is a liquid phenol-formaldehyde layer made of low viscosity resin that can be used in the rapid production of form blocks. It is easily poured into a mold in the liquid form and set by heating. The Baker plastic die shows the advantages of the loss of the other die and some of their disadvantages have been overcome. The original pattern of the form block can be made rapidly and easily of plaster or paper. From this pattern, a negative mold can be made upon a plate of paper and, into this mold, the liquid phenolic plastic is poured and set, and the finished die is obtained with a minimum of labor and without loss of time. The plastic form block, so produced by this method, has no irregularities as to heat transfer as has the usual die, and has about the same low heat transfer as that of the usual die. Consequently, the acrylic sheet that is being formed on the plastic form block does not have the danger of being forced with strain lines that is encountered in the usual die. (Continued on page 305)

Cast phenolic plastics are being used for complex, as well as simple dies for forming acrylic sheets with grooves in both face and edges. The process for fabricating such a die is shown here.

FIG. 4 The pattern can be ingeniously made of wood or plaster of Paris. **FIG. 5** Plaster is poured around the pattern to make a plastic mold for the plastic forming die. As soon as the plastic mold is nearly solidified the shape is spread the use of a perforator. **FIG. 6** The mold is removed. The plastic is mixed with catalyst and solvent until flow and poured into the mold. The setting is then baked for about 2 hr. at 150 deg. F. **FIG. 7** The finished plastic die is easily removed from the plastic mold and is covered with a layer of cloth. **FIG. 8** Finished die is then ready for use in forming the acrylic sheet.





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Magnesium welded structures now feasible. Developed by Northrop engineers, the company has released detailed information for benefit of all industry.

A TYPICAL EXAMPLE of the aviation industry's all-out cooperation for victory (see page 94) was the action of Northrop Aircraft, Inc., in releasing full information on its "heliarc" welding process after two years of intensive development by Northrop engineers.

V. H. Forbush, chief of research, and Elmer H. Smith, welding engineer, together with other men of the Northrop organization, believing that vast new possibilities would be opened up in aircraft design and construction by development of a satisfactory method of welding magnesium, worked tirelessly to that end. They are confident now that these powers joined are the world's of magnesium alloys, vacuum and casting into structures simpler, lighter,

and stiffer than is possible in conventional die-casting construction. They point out, too, that methods of treating magnesium to make it less inflammable and more resistant to heat have been perfected.

While magnesium has been used for some time in the aircraft industry for engine parts, wheels and accessories, it has not previously been used extensively as a primary construction material because of the difficulties in fabricating. Magnesium is the most abundant metal on the earth and in the ocean. About 35 percent of all the dissolved solid matter in the sea consists of magnesium chloride and magnesium sulfate—enough to serve all the land uses of the earth to a depth of 86 to 70 ft. or

3,000,000,000 lb. per acre. The metal begins from the bones of salt wells are always rich both in magnesium salts and bromides.

Nearly all the metallic metals of the earth's crust contain notable quantities of magnesium. Some of them are of commercial importance; examples are alkali, sodium, and calcium, nickel, and molybdenum. The use of magnesium alloys at the present time is greater than aluminum alloys. However, because of new magnesium plants under construction and increased production in the plants now in operation, magnesium alloys will be cheaper than aluminum alloys in a very short time. Twenty-four thousand kilowatt hours are required to produce a ton of aluminum from bauxite and only 18,000 kw-hr are required to produce a ton of magnesium, which has 60 percent more volume. Magnesium alloy will shortly be the most plentiful alloy. The world's largest deposits of bauxite

(Continued on page 22)



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HOSE CLAMPS

Flight Recorder To Ease Test Pilot's Job

The "flight recorder," an electronic instrument capable of recording temperature and pressure changes at the rate of 184 readings every second, has been developed by the Brown Instrument Co., subsidiary of Minneapolis-Honeywell Register Co., to aid test pilots in tabulating vital data on engine and plane performance in flight. It is a portable instrument and is run by magnet regularly by the Army, Navy and leading plane manufacturers.

The instrument automatically records as many as 184 different readings throughout various parts of the plane and automatically prints a record on graph paper at the rate of about one reading approximately every second. As applied to the test flight of airplanes, most of the measurements are those of temperature, although the instrument is capable of recording any physical phenomena which can be transformed into a change of voltage or current.

In the development of records, the device is of importance in so far as it relieves the pilot of making test readings while he is engaged continuously in the operation of the plane. Accordingly, with an instrument of this type installed in the plane, readings will be made regularly and automatically and the pilot may devote his entire attention to the proper manipulation of the airplane controls. Another advantage of the flight recorder is that many more readings may be obtained in a given time interval so that much more complete and detailed information of the flight is available than has heretofore been the case where readings were recorded manually.

The new recorder, which is the result of several years of research, was in the process of development for use in industrial plants when the need arose for some new type of instrument capable of compiling test data on the Douglas B-18, the world's largest plane in flight. To meet this requirement, a group of electronic and mechanical design engineers went to work in the Brown laboratories and adopted the experimental recorder as the product of development for the test run of the huge plane.

The requirements of the unusual flight recorder have been met by the adaptation of a new type of self-inducing electronic galvanometer which completely eliminates the mechanical galvanometer which have been used extensively in industrial equipment for the measurement of temperature. As applied to the measurement of temperature, the minute temperature of any designated part on the plane or engine is determined by means of thermocouples located at the strategic points.

The difference in temperature between the two ends of the thermocouple produces an electrostatic force across its terminals. The voltage across a potentiometer equal to the thermocouple voltage is then selected by automatic mechanical means. Ordinarily, the quality of voltage in the two arms is indicated by a current which in turn is measured by a galvanometer. In the electronic flight recorder, the galvanometer is replaced by a multi-stage amplifier which drives a motor to rotate the pen on the potentiometer to the appropriate position. When the appropriate self-induction is obtained, the correct relative temperature is automatically recorded on a continuous chart. This is the essential method of operation for making one temperature reading.

For making additional temperature readings, a switching arrangement is used to introduce any of the recording thermocouples into the electrical circuit. The switching arrangement for selecting the appropriate thermocouple is controlled with the recording mechanism so that when a wall or balance condition obtains for each thermocouple in the test, its appropriate temperature is automatically printed on the chart paper.

Features of particular interest in the new device are the replacement of the usual type of galvanometer by an electronic amplifier, self-inductor, and motor driving system which enables it

possible to use the instrument in the severe conditions of temperature, humidity, and vibration which are encountered in flight. The stability of the electronic system also gives the instrument its big advantage of making up to as many as 184 recorded readings in about 3 min. If all 184 thermocouples are employed, it is possible to get a reading of each individual thermocouple at an interval of approximately 3 min. If fewer thermocouples are used, it is of course possible to obtain readings of any one of the group in a smaller time interval. An additional feature which results from the improved design is that the instrument can measure to better than 1 deg. F., whereas temperature measurements made with conventional instruments are not so uniformly good and results obtained could not be depended upon in temperatures close than about 10 deg. F.

The flight recorder consists of two portable units in addition to the individual thermocouples which are distributed on the test data requires throughout the plane. Two instruments are contained in boxes about the size of a small suitcase. The electronic amplifier and recorder are in one case and the synchronized recording mechanism for the 184 thermocouples in the other. The complete installation weighs 120 lb. of which 60 lb. are assigned to the recorder mechanism itself. The recorder uses 15 ft. of chart paper per hour which is enough for a flight lasting 5 hr.



The portable "flight recorder" now installed will obtain data on engine and plane performance in flight testing America's new fighting planes. Cost: William C. Day, USA, is inspecting the new instrument with E. E. Smith, vice-president and general manager of the manufacturer, Brown Instrument Co., subsidiary of Minneapolis-Honeywell Register Co.

Speed Up

It takes no longer to inspect a gun barrel than it does to push a cleaning rod through it and no more skill, in spite of the fact, that the Precisionaire is accurate to .0001". Any new operator having no previous experience can be taught to handle this gun in less than fifteen minutes.

The same instrument provided with two slightly different gaging spindles is used to check the bore before rifling and then, by changing the spindle, give it a final inspection after it is rifled.

FIG. 2. This La Poste parcel was specially treated to free soil spring past releases from regular applied herbicide. It has combined several operations into an automatic sequence. The rest of the park has been reduced 33 percent.

The operation performed by the isomarkes on this case was the generation of a box size the pattern which serves as a combination pattern and paper pattern and on all coordinate paper properties. This generates the isoprop. graph on the design the next

The smooth finish of the parts and stone heads, such as the spindle, also possesses the blades, has always been necessary to the people manufacturing them. These simple polishing operations, however, and the fitting of the stones required for the major part of the work of the parts had been required.

Production men of Hamilton Steel and Chain Works, designed a special concrete-pushing head (See Fig 3), with the overstruts obtained by the addition of some incorporation of a work holder and a feed mechanism made the machine semi-automatic and a special hub was designed to force the rods at the bottom of the cone hole.

If dynamic propellers require a large quantity of spring pack retainers, life saving provided for each blade. These small U shaped parts hold the springs which provide the drive between gear opposed and poppet blades for changing the pitch of the propellers. They are in effect the shock absorbers for this drive mechanism.

In an effort to cut down the time required to make these small parts and also to reduce the cost, Hamilton Standard production men studied ways and means of providing an automatic machine.

1. 2. An asymmetric pulsating load for pulsating
disturbance its spectrum is less than six times. For
two and four repeated since three times in long
duration.

[Turns to page 309]

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SKETCH BOOK of Design Detail



The leading edge section of the P-40 with the upper wing covering control doors. The diagram shows: "A" - The ribs are held parallel by channel sections "B" and are attached to the lower spar "C". Disposal bracing "D" are also used. Pivoting struts near the pitch axis are shown section "E" which lead from the fuselage bulkhead "F" to the spar "C". The intake "G" leads to the air duct "H" located inside the wing wing section.

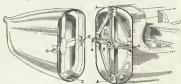


Illustrated above is the new type brake being fitted by the Daimler-Benz to the Daimler-Benz 250. It is made of a disc brake. When the disc is pulled in the disc position the two short legs "A" have been opened by being pulled forward along the bars "B" and supported by the connecting rods "C". In closed position the legs are forced into the hub "D". The entire unit is detachably being replaced by the disc and at night when the plane is being used in its normal function as a disc brake.



Shown here are details of the retractable nose wheel of the Daimler-Benz 250. The main part of the gear is shown in the "A" wheel which is mounted on the side of the nose wheel. The "B" is the retracting arm for the upper retracting link which is held by bearings fixed to the side of the nose wheel. The gear is retracted hydraulically by an actuating cylinder "C". The hub "D" holds the gear in locked down position by means of a strong arm "E" which is a spring-actuated hydraulic cylinder. The gear is retracted by hydraulic pressure actuating cylinder "F" which controls the hub "D" allowing the main retracting cylinder "C" to retract, rotating the wheel up and forward and also retracting the upper retracting link "H" around the side which also leads to the gear. The rings "G" are supports for the nose wheel steering cylinder "H" which are actuated hydraulically.

The detachable tail end of the Daimler-Benz 250 is shown below. The first step is "A" are retracted by the hydraulic bell crank "B" to go to the third step "C". The tail is supported by the bell crank to connect the plane from a step to a disc brake.



VICKERS HYDROMOTIVE CONTROLS

Vickers Hydromotive Equipment is used on many of the most modern airplanes. Republic's P-47 illustrated here is representative.

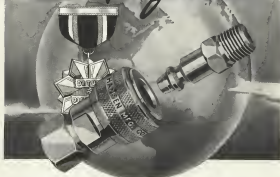
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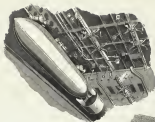


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• Hansen Push-Tite air hose couplings have won world wide recognition on the strength of their remarkable day in and day out performance handling air, gases and oil under every conceivable condition. They're much better because there is nothing to turn, twist or lock—a slight push or pull into socket, it is connected—air is instantly turned on and there is absolutely no leakage of air at any pressure from an ounce to over 14,000 pounds. A

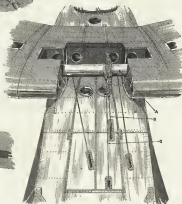
groove pull on sleeve, plug is automatically spaced. Line disconnected, air automatically turned off—no wastage of time, effort or air. Complete control action, eliminates entirely the customary linking of hose. Hundreds of thousands of Hansen Push-Tite air hose couplings are on the production lines in most of the large industrial plants throughout the world, a recognition of merit based entirely on outstanding performance. Send for free catalog.

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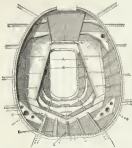


The structure control engine like of the Pratt & Whitney R-2800-A is shown at the right. The engine like "A" is actuated by the cylinder "E" and "C" which are attached to the structure at the base. The leading edge of the structure is a flat plate, with round headed studs (see them in back). The structure are below shown.

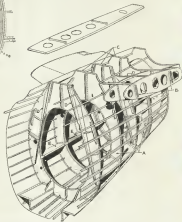
Shown at left are details of the bank ends of the two engine Pratt & Whitney R-2800-A, with one of the large banks in place. The control "A" shows the bank engine from the bankhead's side. The structure like "B" is the structure that goes to the structure. "C" flow through valve "D" to the trigger "E". Different bank ends may be connected for different reasons through adjusting the bank leading gear of varying lengths through the holes "F" in the bank end. Note the large one and opposite through of the structure "G" and then, structure "H" through which the bank lead is also indicated.



The right side of the second structure leading gear of the Pratt & Whitney R-2800 is shown at left. The leading mechanism of "A" is electrically operated so the structure gear shaft which passes the gear "B" is not up to the gear into the wall. From left to right, the valve "C" which controls the fuel valve, this structure the gear for a separate power and for that part of the leading gear "D" is the line from the wheel to the by electric motor. Note that the leading "E" comes only a little way below the hub of the wheel, another gear on the leading gear is in the structure wheel is complete the structure. (The other details of the Pratt & Whitney R-2800 are in the Pratt & Whitney R-2800, page 234.)



The hulked frame construction of the Douglas A-20 is shown at the left. The spine for the section is attached to the bulkhead 'A' which is reinforced with angle. It is attached to the bulkhead 'C' which is braced like the other bulkheads in the section to absorb the full loads. Attached to the bulkhead are bottom stringers 'B' and the top 'D' which are also braced in a T-section. (See also AVIATION's March Book for March, May, June and October 1942.)



Construction of the Douglas A-20 fuselage shows the splices and the way attached to the bulkheads. 'A' is made the same manner that a wing section is joined to the fuselage. The entire point of the section is attached to the wall by four bolts at the stringer 'B'. The 'D' is attached to the fuselage on the same bulkheads along the full section. 'C' shows the reinforcing angle stringer 'D' along the forward bulkhead and those between the bulkheads 'E'.



The wheel assembly of the North American Avenger is shown in which the full section of the fuselage is built of plywood is shown at left. The wire 'A' is attached to bulkhead between the bulkheads 'B' and 'C'. The Filler 'D' hangs on the wheel frame 'E' with the plates 'F' and 'B' taking the load into the bulkhead 'A'. The web 'C' are for struts. (See also AVIATION's March Book for August and September 1942.)



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One of the most important of Camloc's many advantages is the fact that the final assembly is a single unit assembled at the final factory. This means the screw pin need never be removed. It is locked, and additional safety is provided by a clip on the end of the Camloc device. Only the single Camloc head pin is needed to mount the end into the structure. This is of special advantage in installation, particularly when steel wings and associated brackets are being assembled. The use of different length studs does these quickly and easily. Camloc is free to use many factors to installation than other fasteners, and permits tremendous savings in labor time and production expense.

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SHEET NUMBER P-1
CLASSIFICATION Production
SUB CLASSIFICATION Power Presses

POWER PRESSES

The Cushion Size and Ring Holding Pressure Required

(When dimensions of first draw shell are available)

TO OBTAIN the correct draw ring holding pressure for the first draw on a given shell—of one operation or more—the circumference and the thickness of the first draw are required. This also applies to irregular drawn shells.

To find the size of cushion on the draw ring holding pressure required, proceed as follows:

Multiply the circumference of the first drawn shell by the thickness of the stock. This is the cross-section area of the drawn diameter. Then multiply the factor in the table corresponding closest to the thickness of stock used. The result

will be the ring holding pressure required by the pneumatic die cushion. Next, select a pneumatic die cushion, from the specifications shown in the catalog as to ring holding pressure. Taking the pressure required, and dividing by the piston area, you will get the result of the air pressure required by the pneumatic die cushion to draw the shell. If this pressure is higher than what is available from the shop air line, or, that can be supplied, a cushion must be selected to suit the maximum shop air line pressure available. Rules for various thickness of stock follow.

Thickness of Stock	Pressure in lb. per sq. in.	Thickness of Stock	Pressure in lb. per sq. in.
.003	30,000	.060	8,000
.005	27,000	.065	7,500
.009	25,000	.070	7,000
.005	22,500	.075	6,500
.003	20,000	.080	6,000
.005	17,500	.085	5,500
.040	15,000	.090	5,000
.045	13,500	.095	4,500
.050	12,000		
.055	9,800		

On all thickness of stock greater than 0.003 and a factor in the table of 4,000 can be used satisfactorily. For example, the first draw on a given shell, 4 in. in diameter, stock thickness of 0.040 in., the circumference is approximately 12 in. Then, 12 in. x 0.040 in. equals 0.48 sq. in. of cross-section area at the drawn diameter of this given shell. From the table we find that for 0.040 in. stock, we require 15,000 psi, then, we have 0.48 x 15,000, which equals 7,200 lb. ring holding pressure to be supplied by the pneumatic die cushion. From the catalog, we find a 15-in. pneumatic die cushion has 315 sq. in., then, 7,200 divided by 315, equals 23 lb. pressure at which the cushion should operate. If this pressure can be supplied, the cushion is suitable. The ring holding pressure required on various

thickness of stock is as per cross-section area, which varies with the thickness of stock—the thicker stock requiring greater ring holding pressure. The cushion selected should be from the dimensions and specifications shown in the catalog, so that it will pass through the press bed opening. If a single cushion will not give the desired ring holding pressure, a tandem type will have to be used. In general, it is good practice to equip the average press with ring holding pressure, on 100 lb. air line, having one-sixth of the total press tonnage.

NOTE: Ringless Presses Fitted to Conventional Drawing and Press Dies. (Formulas for determining tonnage of material to be stamped, drawn, compressed, etc.)
in length of elongated section of blank or circumference.
AP—pneumatic pressure required by 100,000 psi cushion in pounds.

Courtesy of Dupont Regis Manufacturing Co.



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SHEET NUMBER P-2
CLASSIFICATION Production
SUB CLASSIFICATION Power Presses

POWER PRESSES

Cushion Engineering Data

Tonnage Capacities on Presses

Capacity of Crankshafts at the Bottom of the Stroke

Crank Shaft Dia. Inches	TONS		Crank Shaft Dia. Inches	TONS	
	Single Crank Press	Double Crank Press		Single Crank Press	Double Crank Press
1 1/8	6	12	6 1/2	150	150
1 1/4	7.5	15	7	180	180
1 1/2	9	18	7 1/2	215	215
1 5/8	10.5	21	8	255	255
1 3/4	12	24	8 1/2	345	345
2	14	28	10	440	450
2 1/4	16	32	11	545	550
2 1/2	18	36	12	665	690
2 3/4	22	44	13	790	1150
3	26.5	53	14	920	1400
3 1/8	31.5	63	15	1060	1700
3 1/4	37	74	16	1200	2000
3 1/2	43	86	16 1/2	1300	2100
4	56	112	17	1400	2300
4 1/4	71	142	18	1580	2700
5	88	176	20	1950	2900
5 1/4	106	212	22	2380	3100
6	126	252	24	2860	3300

The tonnage figures do not apply to end wheel type of press with overhauling crank-pins.

It is customary practice to equip the average press with draw ring holding pressure one-sixth of the total gross tonnage. In doing so, you are always insured of equipping your press with the maximum size cushion that will operate satisfactorily on a given press. On the average industrial press, it is usually necessary to resort to custom construction. To figure the draw ring holding pressure produced by a pneumatic die cushion, multiply the surface of the piston or

piston, in square inches, by the air pressure used on the given cushion in square inches. Example: If an 8-in. size cushion is used, surface would be 64 sq. in. If the working pressure from the shop air line to the cushion was 80 psi, 512 tons 40, equals 2,048 lb., which would be developed on the draw ring. In other words, on a 50-lb. maximum shop air line, using an 8-in. cushion, the approximate maximum draw ring holding pressure available would be 11 1/8 tons.

Courtesy of Dayton Engine Manufacturing Co.

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such as tubular assemblies where the starting and finishing ends of a single mold speed overlap. In operation, the welder inserts an electrode in the clamp, presses the start button, and the equipment strikes and welds the rim, finishing the electrode at proper rate to maintain the joint as voltage. Welding continues until stopped by a limit switch, at which time the electrode clamp returns to starting position to insert a new electrode.—*Aviation, November, 1962*

Hydraulic Press

Hydraulic Machinery, Inc., Detroit, Mich., is introducing a 25-ton pressure press of the following specifications: 30 in. stroke, 50 in. of height, 4 in. per sec. closing speed, 8 in. per sec.



fast advance speed, 5 in. per sec. open up speed, 25 in. from base to 18½ in. at platen, evacuation pump, relief, choke and recirculator valves, 7½ hp, 1,200 r.p.m., 3 hp 60 cycle motor. The press is of welded steel construction mounted on a fixed base 39½ in. and the overall height is 120 in. Power and may be installed in another room or building.—*Aviation, November, 1962*

Sensitive Drill Press

A new Superintensive Drill Press for extremely small drills and other tools is announced by the Edward Blake Co., 624 Duane Street, New Canaan, Conn. The machine has a standard range of eight speeds from 1,000 to 21,000 r.p.m., said to give proper surface speeds on drills from .005 in. or smaller.



to 1/16 in. diameter. Sensitivity is obtained by balancing the spindle in weight of the vertical component of the belt tension. Machines with one, two, three and four spindles can be purchased. Each spindle is equipped with an independent finger control and each spindle can be run at an independent speed to suit the size and type of tool being used and material being cut. Standard equipment includes two spindles for each spindle mount, one for Z-axis cut and one with tapered hole for tapered shanks.—*Aviation, November, 1962*

Hand Screw Machine

Developed to meet the need for tools capable of accurate and continuous production, the No. 800 hand screw machine with capacity for 4 in. round bar stock has been introduced by Lucas Engineering Co., 4905 Lawrence Ave., Champaign, Ill. Features of design and construction listed by the manufacturer include: precision ground bed with two precision V ways and two flat ways, precision, pre-loaded ball bearing spindles, mounting, turret holes bored from the headstock, turret and cross slide provided with adjustable pins to compensate for wear. A new speed index chart for round work which may be fed through the spindle and a bar feed attachment are offered as an accessory.—*Aviation, November, 1962*



Vertical Turret Mill

The "Perfect 35" vertical turret mill for boring, drilling and turning ferrous and non ferrous castings, forgings and smaller parts, has been introduced by the Rogers Machine Works, Inc., 125 Arthur St., Pawtucket, R.I. The specially designed turret head and main bed permit two operations simultaneously. Incorporating the critical design in the side head, shoulder and complex bed surface for complex parts, it said to



be possible due to the ability to tilt the side head at any angle up to 30 deg. either way. In addition to the vertical side head and "table level" horizontal chuck, the mill has a motor driven traverse, heavy duty ways, clutch running in an oiltight case. Main and side heads have 6 vertical and horizontal feeds each.—*Aviation, November, 1962*

Balancing Machines

Available in a variety of models ranging from bench size to large floor-mounted portable models, the balancing machines produced by Rotar Mfg. Co., Industrial Division, Rock Island, Ill., are said to show both angular position and amount of imbalance at the same time. It is said that with the machines it is unnecessary to static balance before a dynamic balance test can be made, and that the machines reveal whether a static or dynamic imbalance is present without reversing ends of the body being balanced.—*Aviation, November, 1962*

SHOP EQUIPMENT & ACCESSORIES

Moisture Registers

Two new moisture registers especially adapted to aircraft work have just been developed by **Mohrman Register Co.**, 3117 Kinzie St., Los Angeles, Calif.



One model has been designed for use with regular heaters, the other a variation for heating vacuum and pressure as thin as $\frac{1}{16}$ in. It is said tests can be made positively instantaneously, and very little training is required to use the scale since results are shown on reading dial. The instruments are portable, the total weight being but 5 lb.—*Aviation*, November, 1942.

Air-cooled Welder

A new air-cooled heavy duty welder, designated the 250 "F" has just been introduced by the **Republic Machine Works Co.**, Lawrence 61 at Erie Ave., Philadelphia, Pa. The air cooling is designed to reduce the thermal stress which causes the reduction of ordinary



welders making it particularly adaptable to constant work necessary for today's production schedules. Capable of handling an electrode from $\frac{1}{16}$ to $\frac{5}{16}$ in., the new model has 24 heat stops, an output voltage of 200 volts and a current range of from 10 to 250 amp. The 250 "F" has a 60 cycle frequency and operates on a single phase in one place of a two or three phase system.—*Aviation*, November, 1942.

Selector Valves

Two new four-way Indiana selector valves, just announced by **Reedley Aviation, Ltd.**, North Hollywood, Calif., bring the line to new models, covering every tube size and style from $\frac{1}{8}$ to $\frac{1}{2}$ in.



$\frac{1}{2}$ in. including dual and triple bank valves, all duplicate the basic radial design using co-axial shafts which permit all handles to be operated simultaneously when desired. For ease of use, low pressure drop, and plastic poppets are features of the flexible valves. The newest models are for 1-in. tube size with integral check and relief valves, and for 1-in. tube size.—*Aviation*, November, 1942.

Reflex Camera

A highly mechanized camera which has been used in photographic measurement readings has been developed by the **Mohrman Camera Corp.**, 273 Madison Ave., New York, N. Y. It differs from other reflex cameras in that sight as well as inverted image is visible up to the moment of exposure. The image may be viewed by means of an auxiliary mirror when the camera is above eye level. A new type, distinctly open-up hip-point shutter requires no manual re-setting for taking consecutive pictures. Exposure range is from 1/120 sec. to 1/1 sec., with the exposure dial being illuminated like a radio dial.



Three sizes of pictures can be made 340, 440 and 547 with capacity for 344, 360 and 151 exposures respectively. New film is automatically moved into place after each exposure. As each film is exposed, an identifying number is automatically marked on the margin, forming a permanent record. In addition, the camera has two other features, one to keep track of the number of exposures made for each subject and one that records the amount of film used and the amount still left in the camera. An electrically operated mechanism makes it impossible to operate the camera until the safety slide has been removed. Remote control is also provided. The camera is approximately 1 ft. high and made by 14 in. long and weighs less than conventional studio cameras.—*Aviation*, November, 1942.

Adjustable Service Stand

A new portable and adjustable work platform for servicing large aircraft has been developed by **Patrick Engineering Corp.**, 3115 San Fernando Road, Los Angeles, Calif. Height can be adjusted from 3 to 10 ft. by means of hydraulic steel equipped with machined safety pins. Of all-metal construction, the stand is designed to safely support

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Oxygen Manifold

Reed Aircraft Corp., Lancaster, N.Y., announces an oxygen manifold, a pressure assembly designed to direct



Matched Assembly Units

A line of matched assembly units, called the RTV group, designed to facilitate handling and moving metal aircraft engines from parking area through final stages of engine assembly build-up has been introduced by Aviation Research, Walling Corp., Elmhurst, Ill. The group includes Model E engine cleaning stand for metal operations in sliding preliminary assembly installation; Model T engine transfer cartage, which fits into the other two units to supply transfer of engine from one to the other without overhead handling and for additional assembly installation; and Model K, variable speed build-up unit, which provides support for final assembly, cooling, planishing, wing and other installations. Tubular construction provides simple design with maximum maneuverability. The units are available in various capacities for all sizes of large radial engines.—*Aircraft, November, 1942.*



the flow of oxygen from an outside source to service tanks, from service tanks to the regulator or to other equipment necessary, an oxygen manifold to high altitude work performance. The new unit has been designed to prevent loss of total oxygen supply in event of a direct leak (up and is reported capable of increasing any number of leaks either severely located or dispersed throughout the plane.—*Aircraft, November, 1942.*

Screw-Holding Screw Driver

A new magnetic screw-holding screw driver has been developed by William Mfg. Co., 303 Washington St., Boston, Mass. A gripping lower section is set out of the ground blade to hold the screw securely while it is being turned or driven. This is operated with one hand, and compresses both two moving parts, the lower itself and a slide, placed near the handle, which is moved

down to grip the screw, up to release it. It is said the driver can be used with screws of any material—brass, steel, aluminum, etc., etc., so elements are of wire, plastic, glass and other means of holding screws in place where the operator's free hand cannot reach.—*Aircraft, November, 1942.*

Parts Testing Chamber

To test aircraft parts and valve equipment used in high altitude work, Kolls Magna Mfg. Co., Lansing, Mich., has developed a stratopneumatic chamber operating between plus 200 deg. F. and minus 70 deg. F. with an internal pressure variation from vacuum at the bottom of the test to 3 in. of mercury absolute. Both pressure and temperature variations are controlled throughout their ranges. The unit, which uses Freon 12 as refrigerant, has an interior chamber capacity of approximately 10 cu. ft. Chamberly control is from 20 to 25 percent, relative to all temperatures where plus 40 deg. F. or at a fixed bottom temperature of plus 32 deg. F. Heating equipment is composed of strip heaters arranged so that the forced convection circulation air during the



test cycle. These indications are provided for continuous recording of temperature, pressure, and humidity. Flexible mechanical connector shafts through the water seal project inside the test, permitting placement of flexible or rigidly rigid shafts or rods held down. Machine electrical connections are also provided.—*Aircraft, November, 1942.*

Compressed Wood Mallet

Harmless and flexibility of wood is increased through a patented chemical and compressive process employed in manufacturing the Eucade Presswood Mallets of the Eucade Electric Mfg. Co., 5100 N. Rosewood Ave., Chicago, Ill. The new mallets are three sizes and weights—can be produced in quantity and are available on short notice without penalty.—*Aircraft, November, 1942.*

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American PLUS Phillips Screws in Lockheed aircraft



Lockheed selects "American PLUS" in front of "Phillips" on its orders for recessed head screws

Springless Cowl Fastener

A new type steel fastener that has received Army Air Forces approval is announced by the King Engineering Co., Corona, Calif., and now comes, the 5, in its production. Yielding up the air either comes, the 3, is in progress. The new fastener is unlike other devices in that it is not dependent upon springs but locks and unlocks by means of a screw action which produces very desired amount of tension. This variation accommodates a wide variety of sheet



thickness, thereby reducing the number of sizes necessary to stock. Developed in collaboration with the engineering departments of several of the

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ibly out of the desperately needed bars—all but one. A shipment of 2 1/2 WD X4130 rounds was just arriving at one of the Ryerson plants. The one was immediately opened and the same evening the steel was on its way to the airplane builder. A production bottleneck was broken.

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New Products

major aircraft companies, the King fastener will stand tension loads of 3,000 lb., approximately 50 percent more than AN specifications, and shows loads up to 3,700 lb., or nearly 250 percent in excess of AN requirements. It is held on or released readily with a screw driver and the portion of the locking member of the stud is shown by an indicator—Arverson, November, 1942.

Copying Machine

Photo Reproducing Equipment Co., Chatham, N. J., has introduced a line of reproducing machines known as Tri-copy-photos designed to make accurate reproductions of anything written, printed, drawn or photographed in actual size. A single copy can be made in about 13 min., with additional copies requiring about 1 min. more each. Both air and electric and portable hand-



try models are available. No facsimile or stenciling, and excellent reproductions in real required—Arverson, November, 1942.

Failed Guide Block

A new Bend-A-Mag adjustable leaded guide block that is universal for any angle of cable is being introduced by Transamerica Products, Inc., 3070 Fulton Road, Cleveland, Ohio. The new block is composed of a three-piece cast metal plastic guide block bonded between an aluminum base and a spiral spring steel spread bar, and accurate. (Come to page 173).



"TRIAL-TEST"
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OUTSTANDING GRINDING QUALITIES.—"Outstanding grinding qualities. Wheel was cut 10" on 50 per ground. Edge held up." (Grinding shafts in grinders at 3200 R.P.M., averaging .005" stock.)

NO LOADING, NO BURN.—"Cut finish, did not load and no surface steel without any trace of burn. Obtained at least 300% better production." (Facing tool steel gear 5 LE 41-50 at 3140 R.P.M.)

WELD EDGE WITHOUT DRESSING.—"Gave 50% better production than competitive. Held edge without dressing. Ground 600 pieces—average .004 per hour." (Grinding hardened steel loadings on B & S.)

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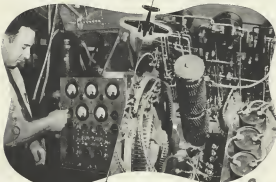
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OHMITE Rheostats, Resistors in Electrical Analyzer for Aircraft



Analyzer Saves TIME for Republic Aircraft

The electrical analyzer, devised in the wiring laboratories of the Republic Aviation Corp., was designed primarily to speed up aircraft wiring and locate trouble without disconnecting any wiring. It also enables making adjustments on all electrical equipment prior to final assembly, for it is able to duplicate any missing circuits or leads. It also enables a direct analysis of any error in wiring assembly, indicating the exact location of circuits in error. Wide variation of power output makes it adaptable to any type of service or testing.

The use of Ohmite resistance units in this aircraft electrical analyzer is another indication of how Ohmite products help speed war production—how they help test planes as well as fly them.



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have their bases reinforced with asbestos-lined mechanical straps to withstand the high temperatures of fused installations. The resistor type, being built on refractory linings of pure silver sealed inside the bulbs for protection against drawing and burning by fumes or dirt. Average bearing life of all the lamps is said to be in excess of 5,000 hrs.—*Aviation, November, 1942*

Wire Rope Sling

A new wire rope sling, called Flatwire has been developed by John A. Boulding's Rope Co., Trenton, N. J. It is said to be used for light, flexible, non-spreading slings to handle light and medium loads. These slings have a flat

radius, radius up to 1/32 in. diameter for a 25/32 in. diameter is a single wire, except for the diameter line, is used for making a control cable from 1/32 to 1/2 in. in diameter is two pure galvanized galvanized plastic grade is available. Several complete is incorporated into the plastic so that the grade is self lubricating.—*Aviation, November, 1942*

Infra-Red Heat Lamps

A new line, containing six clear types, three tube types and four reflector types of infrared heat lamps designed in keeping with U. S. P. requirements, has just been announced by the Hinkley Division of the Whelan Apparatus Corp., 535 Carroll St., Brooklyn, N. Y. All feature the U type tungsten filament for uniform heat distribution and

heating surface which is said to allow an even pressure on each of the six types which comprise the line. Two types of ropes are used in opposite directions. These are sealed into a finished design by two single tie ropes which ultraviolet, gas back and forth around one pole and then the other in a spiral figure 8. This method is said to eliminate stresses or drawing action between the various rope. Compact steel sleeve are composed of steel all rope (size 1/8



previously serving them.—*Aviation, November, 1942*

Instrument Test Chamber

American Gish, Inc., Newark, N. J., has developed a new chamber for testing instruments in operating temperatures ranging from minus 55 deg. C. to plus 150 deg. C. It includes apparatus for mechanical refrigeration and electric heating. Operation is provided by an inner door with five glass windows and a dedicated control passage of moisture, with the visible opening measuring 21x40 in. The adjusted cabinet occupies space 33 in. wide by 30 1/2



high by 42 deep, with inside exterior measuring 20 in. wide by 28 high by 30 deep, with an interior volume content of 267 ft.—*Aviation, November, 1942*

Har Protector

To protect women employees working with moving machinery, Standard Safety Equipment Co., 212 W. Ontario St., Chicago, Ill., has developed three styles of Har-Safe Har-protectors. Completely ready to put on or removed, and the mesh of the guard allows enough flexibility to keep the worker's head cool.—*Aviation, November, 1942*

Propeller Balancing Way

Anderson Bros. Mfg. Co., 1850 Indianapolis St., Rockford, Ill., has introduced a new Static Balancing Way designed especially for non-rigid propellers. Designed in a few cost units, it has been developed in such manner that it is available in many service stations which were not have such equipment.

AVIATION SCHOOLS TRAIN WORKERS WITH CP TOOLS



↑ STUDENT IN CHICAGO aviation school fabricates shafts step by step with a CP 127 RASP. Pneumatic Mowbray design type. Latest CP solution tool developed. The CP 127 RASP (remachining) works in only 8 1/2" long, weighs only 3 pounds. For best results place three or 45° and 90° angle dies inside at the same time.



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one of each table, 8 to 32 in., with 1/2 in. actual impedance 7-1/2 in. at center, over 7/16 in. diagonal oval hole. The entire machine occupies floor space of 34 1/2 in. by 34 1/2 in. 44 in. high—AUTUMN, December, 1944.

New Type Hose Clamp

A self-locking, non-spring hose clamp that requires no bolts, nuts, leading screws or pins, and can be installed by hand, without tools, is announced by Huntington Pressure Products, Huntington, W. Va. A division of Akl Precision Products Corp. L. A. variety of pressure in greatest degree.



Circular Saw

A new continuous use saw with several features makes this circular saw which can be readily sharpened on an automatic grinder, has been introduced by Burt Dorton & Sons, Inc., 1400 North St., Philadelphia, Pa. The sawed action design is in part a thinner blade and cutting edge that is ordinary with saw having a double fluted tooth, and transfers the cutting load from each tooth directly to the blade approximately at right angles to the cutting force. The full thickness of the blade extends to the extreme diameter, a feature which is said to give maximum support to the teeth and at the same time permitting long life. The teeth are quickly and easily replaced should they be damaged by accident. Blade work can then be done on the user's own plant or a nearby saw repair shop. The new unit

Arc Welding Electrode

Designed primarily for use in welding aircraft tubing and assemblies, a new electric arc welding electrode called the Harsco-Hut has been added to the line manufactured by the Harsco-Hut Corp., Milwaukee, Wis. The new electrode, which is supplied in a complete range of sizes in standard and long lengths. Physical and chemical properties and welding procedures will be supplied on request—AUTUMN, December, 1944.

Arc Etching Machine

An electric arc etching system for permanent identification of parts, tools, etc., has been developed by George Dorton Machine Co., Boston, U. S. A. Known as the Spindle Model A II, the machine employs the Dorton extensive arc design to reach inaccessible places such as cylinder interiors, nozzles or high sides of two-blade Etching depth is variable by one dial control, from .0001 to .001 in., with a variable diameter of electrode from .005 to .015 in. Dimensions are: 10 in. height from 1/32 in. up. Operating on 220-240 v., 60 cycles a.c. only, etching voltage is stepped down and it variable from 3 to 9 v. Dimensions are as follows: vertical capacity, 10 in. to 12 in., with cover 8 to 10 in., without cover 8 to 12 in., normal spindle distance, 10 in. to 12 in., for 3/2 in. diameter, 1/2 in. for 1/2 in. diameter, 1/2 in.



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Member Society Plastics Industry

can be operated at speeds up to 5,000 rpm—Aviation, November, 1942

Plastic Gage Handles

To overcome the shortage of metal, Federal Tool Corp., 805 S. Leona St., Chicago, Ill., has developed a line of plastic gage handles. Initially made of standard aluminum except for the handle. As the plastic ma-



terial is lighter than metal, a lighter touch is possible and the possibility of fatigue from long use is said to be reduced. They are made with the same bolting design used for standard metal handles. Aviation, November, 1942

Rocker Arm Welder

A new line of rocker arm welders for doing simple resistance welding has been announced by Progress Welding Co., 8 Outer Drive, Detroit, Mich. This is a unit is available with the Reeves D Charge regulator discharge controls as well as the Ford-type interlocking unit for faster welding. Designed for aluminum welding, the new machine has a reliable stroke of 4 to 12 in., depending on theory depth. It is shown in a free trial by mail during a test week. In welding stroke has a range up to 3 in. Differential action desired on cylinders



New Products

des are used for the welding stroke, the cylinder has return stroke being smaller than that for the pressure stroke. As a result, no pressure can be maintained continuously on the return stroke cylinder to insure prompt port opening after completion of the weld. Port opening is accomplished by advancing the return stroke of the cylinder by means of a timing valve on the side of the machine, an exclusive feature.—Aviation, November, 1942

Spot Welding Tip Cooler

A new self-contained cooling apparatus which circulates a special non-corrosive, non-polluting solution through welding tips of a spot welder is now being produced by Fairbanks, Morse & Co., 680 E. Michigan Ave., Chicago, Ill. A P-36 built an automatic pump, operating continuously with the compressor, circulates Frost II refrigerant through the vaporizer for high heat transfer. As P-36 built in the pump regulates the special solution of high specific heat characteristics from the coil in the welding tip, and back to the unit. Thermostatically controlled, two valves—on-charge—prevent, as well as the pump is equipped with high pressure relief. The

valve set is 35 in. high and occupies 24x48 in. floor space.—Aviation, December, 1942

Ball Measuring Arm

The George Schaefer Co., 128 Lafayette St., New York, N. Y., has now developed a ball measuring arm and fan on the ball measuring arm designed to speed and simplify measurement of that work with air, rivets, laminates, sheets and cylinders and paper and other flat work. With the ball cover the



work is placed between the flat holder panel and the round ball surface and dependable results are said to be obtained regardless of which part of the thin piece under inspection is being measured. Another feature is said to be that before or purchase of large thin pieces in all positions and on all parts of the work can be checked.—Aviation, November, 1942

YOU CAN REDUCE THIS "AID AND COMFORT" TO THE ENEMY

W.P.B. RECOMMENDS GOOD LIGHTING TO REDUCE ACCIDENTS

The following appears on page one of the publication "PLANT EFFICIENCY", issued by the War Production Board:

CC lighting examples of close relationship between the quality of lighting and accident frequency are too difficult to list. In many factories are involved in industrial accidents that is practically impossible to say what percentage is caused by poor lighting. It is reasonable to assume, however, that much of the cost per hour and greater clarity of vision which good lighting makes possible, thereby benefits will be increased hours and more clearly, with correspondingly increased amounts of working hours.

HOLOPHANE HAS PIONEERED IN GOOD LIGHTING—SINCE 1898

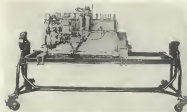
For more than two generations, this organization has concerned itself with the improvement of illumination in American enterprises. All through these years, Holophane engineers, in the field and in the drafting rooms, have played an important role in the development of PLANT EFFICIENCY for industry. Since Paul Harker they have shown hundreds of plants the way to better, smoother work production through lighting designed to meet specific manufacturing needs and working conditions.

The Holophane principle of light control calls for protective glass cases, which ensure a maximum of natural light. They provide efficient light for constant working areas with unusual savings in power costs, electric power and maintenance costs.

FOR SAFE, EFFICIENT ILLUMINATION, CONSULT HOLOPHANE ENGINEERS

Plant management is urged to investigate the actual situation that Holophane lighting can bring to the plant today. Without charge, the Holophane engineering department offers consultation and recommendations for the most effective, economical illumination. Write for the latest Holophane book "Lighting for American Industry", available to everyone.

HOLOPHANE CO., INC.
342 MADISON AVENUE, NEW YORK
HOLOPHANE CO., LTD., 345 ROYAL STREET, HONGKONG, CHINA



Engine Rebuilding Stand

A welded tube and angle iron engine rebuilding stand, which can be demonstrated by instead of hot light bulbs, has been put in production by Motor Rebuilding Specialist 2534 R. McKinney, Ave., Chicago, Ill. It can be folded and stored into about one-fifth the space of an aerial and A. 45 to 1 gear ratio permits easy rotation at the cradle in any convenient operating position. The stands are available for both radial and in line engines ranging up to 1000 lb.—*AVIATION, November, 1942.*

Circuit Breaker

Designed for aircraft and other wartime conditions, the new Series 1500 circuit breaker, manufactured by Spencer Thermostat Co., Allentown, Mass., has the same mounting dimensions to the standard A-17 mechanical fuse switches. It is a self-operated device with mounted reset which gives shock-proof and vibration-proof protection against harmful overloads. Self locking is available for mounting in standard and the breakers can be hot either with



built to use in fusible glass or ordinary adaptable in conventional wiring.—*AVIATION, November, 1942.*

New Hydraulic Jack

Desired for use at fields and elsewhere, airplanes of various types and sizes are serviced, a new, variable height hydraulic service jack, is now

plain or business tipped with button.—*AVIATION, November, 1942.*

Welding Flux

A fluxing flux for gas welding of aluminum and aluminum alloys is now being manufactured, under the trade name Flo-Flu Flux, by Park Street, 3085 Carter St., Washington, D. C. It is especially adapted for small work, the flux is being used to gas weld either wrought, cast or high tensile aluminum or aluminum alloys of any size or shape, when welding is possible.—*AVIATION, November, 1942.*



Abrasive Cloth Specialties

A line of abrasive cloth "clothes" has been developed by Tels Manufacturing, Troy, N. Y. for use on portable tools, power tools, etc. Designed to do in seconds what would require minutes by hand operation, the "clothes" (abrasive ends) Cloth abrasives have been

built, manufactured by the Malabar Machine Co., 2775 Santa Fe Ave., Los Angeles, Calif. Quality adjustable length of looped loop general variation is height from 36 to 124 in. with a 45 in. 3/4. The run is equipped with a patented locking arm which moves down fold against roller of support in previous setting at load. The model shows



★ Woodworth employs a nearly equal number of men and women, by Miss Winter, personal records with these 80% women and 20% men.

TO N. A. WOODWORTH MEN AND WOMEN FOR "Outstanding War Work"

Men and women of N. A. Woodworth Company have received the only military decoration given to civilians, the Army-Navy "E" Award. ★ ★ ★ This signal honor has been accorded with sober consideration of the greater responsibilities it demands. Having publicly acknowledged our production accomplishments, the Army and Navy expect us to maintain and even surpass past efforts as America's Armed Forces step-up the military pace against Axis aggression.

★ ★ ★ Mighty bombers, deadly fighter planes are important if integral engine parts fail to speed the stress of combat flying. In manufacturing over 100 highly precision engine parts, Woodworth employees keenly feel their responsibility in this country's war effort. ★ ★ ★ Management and labor are pledged and anxious to meet any new production goals and mechanical requirements set forth by the Army and Navy to always be worthy of the "E" Award.

N. A. WOODWORTH COMPANY

AERODROME ENGINE PARTS • PRECISION TAPS • HEAVY TAPPING, PLATING • PRECISION GAGES
FERNDALE, MICHIGAN



POWER TO WIN

NO FIRE HAZARD
Fuel will not burn even when subjected to open flame

LOWER FUEL CONSUMPTION
Uses only 20.5 per gallon to develop 100 horsepower—maximum rated output

NO IGNITION SYSTEM
No spark to start, no maintenance, no breakdowns

DEPENDABLE OPERATION
Runs A.T.C. standard for engine use, gives more than 10,000 hours life

THE GUIBERSON
AMERICA'S ONLY RADIAL AIR-COOLED DIESEL ENGINE

The same fundamental design makes the Griberson high speed radial drive the engine to build on the borders of today's world, in the air and on the sea will win world leadership for America in the field of gas war transportation. No other engine of operation at lower weight per H.P. provides such dependably low cost for safe power in the Griberson radial diesel. Backed by more than 12 years of engineering development—is the engine with the power to win

Griberson U.S.A.
GUIBERSON DIESEL ENGINE COMPANY
Dallas, Texas

• THE GUIBERSON CORPORATION
Aircraft and Motor Division

has a capacity of 35 has recently and 7,500 lb. bi-monthly. Other models of capacities from five tons up are also in production.—*Aviation, December, 1942.*

Three-Way Vane

Universal Van & Tool Co., Patuxent, Md., announces a three van 124 to hold work gently for cutting, drilling, boring, reaming, grinding, shaping, die setting, and other operations. The



double central spindle—each allowing 90 deg. adjustment—can be held overloading base—allowing 360 deg. rotation—give rise three separate motions, individually adjustable and lockable. The work holds are 2,000 lb. torque tested. Jaw opening is 5 in. Weight of the unit is 78 lb.—*Aviation, December, 1942.*

Duplicator

Available without priorities is the new Automatic Rotary (Electric Driveline designated Model 10), recently developed by Devin, Inc., Harrison at Oakley Blvd., Chicago, Ill. It is made in both automatic and hand fed types designed to deliver, from original writing, 10 pages or drawings, up to 150 copies—70 per min. on automatic feed machine, 40 per min. on hand feed type machine, and full reproduction night copies continuously.—*Aviation, December, 1942.*

Communication System

A new combination of standard features of the Elexcom system is incorporated in the Executive Message communication system produced by

Exelcom Inc., 415 Lexington Avenue, New York, N. Y., wherein three master stations can be connected with 25 remote stations. The Executive and Message stations can talk to each other, or either can serve as two-way amplified voice conversations with remote desk or transport-type installations in existing departments. An interpreter central feature enables an operator at the master station to interpret all incoming calls originating at remote stations.—*Aviation, December, 1942.*

"Slide Rule" Metal Specifier

A new perforated slide chart which provides a blueprint of American standard dimensions and data for all sizes of elementary parts such as nuts, bolts, pins and lock washers, keys, pipe threads and sizes of tap drills is being made under the name Elexcom slide chart, by Elexcom Sales, Tennessee, N. J. Specifications can be obtained with one movement of the slide, which also gives dimensions of hex-nutnuts, fillets, round and hex-nut heads. In addition, the slide carries translations on decimal equivalents sheet and plate gages, twist drill and steel wire gages and conversion figures between millimeters and inches.—*Aviation, December, 1942.*

Welder's Cover Glass

A new cover glass for welder's hands and goggles called Kloroxer is being marketed by Garco-Loxamer Co., 225 W. 11th St., Los Angeles, Calif. Replacing a wire telescopic, it is used



that the new material will stay clear for more than 700 hours of working time, repelling sparks and carbon dust.



with which it comes in contact. The "441 hours" which this is ordinary glass are and to date of the new material.—*Aviation, December, 1942.*

Life Trucks

A new line of 1,000 lb. capacity life trucks of lifting fork type, telescopic and non telescopic, has been introduced by Lewis Shapard Co., 125 Walnut St., Watertown, Mass. Available with either electric or gas power units, the trucks have low-slides, one piece, rubber and provision of shock absorbing device.—*Aviation, December, 1942.*

Make your deposit in the bank

SCRAP piles are much more than mere collections of trim ends, cuttings, useless machines, parts and junk these days. They're vital national resources—*American Tradejournal*, in fact, in this critical year, because the nation's steel producers will need several million more tons of scrap in 1942 than ever before, if the demands of war production are to be met. • How much can you contribute? Not just the usual scrap flow from your operations, but *all* the idle metal around your buildings and yards that at isn't absolutely essential to keep. Your deposit in the scrap bank will pay dividends all over the world—*make it a real steel!*



BRIDGE BUILDERS • PITTSBURGH, PENNSYLVANIA

High Speed Driving Tool

Recently introduced by the Aero Tool Co., Berkeley, Calif., is a new high-speed ball bearing driving tool known as the Aero Tool Speedball Drive. According to the manufacturer, some jobs can be greatly speeded by this



tool, which drives screws, counter-bolts, or removes loose replaceable tips, conveniently stored in the recessed handle, gives the tool a wide variety of uses. It can be supplied in several shapes for special work with tips for Phillips screws, slotted head screws, set screws, or for turning and screwing into jobs. A tapered shank on the top allows for work removal but will not permit the tip to turn in the tool—*American*, November, 1942.

Air Motors

Smith-Johnson Corp., 625 E. 12th St., Los Angeles, Calif., has developed a line of air motors with universal universal valves, for use where compressed air motion is required. An advantage to combine tools, the motors are used to save time in opening and closing valves and holding failures, opening chutes and latches, moving work pieces and tools in and out of each other and similar operations. The motors, several sizes, can also be used as prime movers for supplying mechanical horsepower in such operations as the driving, pushing, hammering, clamping, the cutting and holding reaction. Dual

valve ports provide for selective utilization of exhaust air. Means for operating work pieces, changing cut steps and providing adjustment of speed of use in both strokes available in standard models with strokes of 11 in., 20 in., 4 in. and 8 in., with other sizes ranging from 1 to 16 in. available on special order—*American*, November, 1942.

Circuit Breaker

A new type A-C line circuit breaker designed for automatic electronic systems using a direct current power supply of 20 v., or less has been announced by Westinghouse Electrical & Mfg. Co., Dept. 2-V-21, East Pittsburgh, Pa. The breaker affords both circuit operation and protection in one unit that can be installed in the usual mounting space on the present line switch. It has a rating of from 5 to 50 amp. at 20 v., d.c., and a 1,800 amp. interrupting



capacity. The unit is normally operated with a 50 dog-ear on the handle from the off to on position—*American*, November, 1942.

Direct Reading Tachometer

A special read type, direct reading tachometer for testing aircraft instruments has been developed by the Merwin Co., 2005 W. 121st St., Cleveland 18, Ohio. It has a flexible scale arrangement so that the single instrument can be used to test all aircraft instruments operating on the pressure or vacuum principle. The Model A-500 incorporates an adjustable scale indicator, permitting selection of proper scale for the particular instrument under test. All scales are adjustable to



each barometric condition in any type of the healthy and an direct reading in air-pressure, limits, pounds, inches of mercury, etc. The range is from 0 to 31 in. of mercury or water. An is digital system will provide line of sight reading tool—*American*, November, 1942.

Metal Etcher

The Ideal Commutator Dresser Co., 3140 Park Ave., Stoughton, Ill., announces a new electric etcher designed for permanent marking of anything made of steel, iron or brass alloys. The new unit has 11 etching heads between 125 to 1,200 watts. A red lamp on front of the machine indicates when power is on and burns brighter on each higher heat to read. Depth of mark can also be controlled by speed of rotation. Spout heat radiating line and other up most are provided. Boundary cables have automatic connection, work plate is 4x7 in., with ground clamp attachment, 175, 50-60 cycle standard, weight, 22 lbs.—*American*, November, 1942.





★ ★ ★ EXTRA ★ ★ ★

LYON STARTS AIRCRAFT PRODUCTION IN NOVEMBER

First Contracts Cover Manufacture of Ailerons, Rudders and Elevators IN ALUMINUM

Capacity Available to Produce Many Aircraft Parts in Both Aluminum and Steel

Investigation of Lyon Facilities Invited

● Now—Lyon is equipped to produce aircraft parts. Facilities are available to work in sheet aluminum as well as steel. Workers for this new Lyon Aircraft Division have been specially trained in actual production by working in aircraft plants.

Aircraft parts in production include Ailerons, Rudders, Elevators, Vertical Fins and Stabilizers. Plant facilities are available for manufacturing additional aircraft parts, assemblies and sub-assemblies in aluminum or steel.

We invite your careful investigation of Lyon facilities as a dependable source of supply.

Our illustrated brochure, "Craftsmen in War Production" contains interesting data on our two plants and details of our 43 years of production experience with metal.

LYON METAL PRODUCTS, INCORPORATED
 1100 N. 1st St., St. Louis, Mo. 63102
 Branches and Subdivisions in All Principal Cities



Investigate LYON FACILITIES FOR PRODUCING

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|-------------------------------|------------------------------------|
| 1. Wing Tips | 8. Nozzles |
| 2. Fire Walls | 9. Transport Cabin Benches (Seats) |
| 3. Doors—Cabin and Bomb Bay | |
| 4. Cowling | 10. Elevators |
| 5. "Control" Surfaces | 11. Vertical Fins |
| 6. Wing Struts, Bracing, etc. | 12. Stabilizers |
| 7. Wheel Parts | 13. Gun Turrets |
| | 14. Hops |

Above is only a partial list of parts on which we can offer production help.

Subcontracting As a Permanent Policy

An integral part of United Aircraft's prewar program, it has aided materially in rapid expansion to meet war schedules.

SUBCONTRACTING by United Aircraft Corporation has proved so successful that the amount of work "farmed out" today ranges up to more than 50 percent of the total volume of work being done by its three operating divisions. Pratt & Whitney Aircraft, Brewster Standard Propellers and Vought-Sikorsky Aircraft.

Yet meeting production schedules which have been increased many times since 1918 with the help of subcontractors has not been accomplished without leadership for both the corporations in its spheres. Rather, leadership is the volume now being handled by outside producers has been accomplished over a long period of time in which a reliable handling of know-how has been maintained.

United's vast subcontracting program is best selling by means of a rather informal committee of executives representing management and production engineering and purchasing departments, with the latter handling most of the details and liaison work.

Many members of this group are also members of the corporation's War Plans Division, which was set up long before the United States entered World War I, and which prepared both the expansion and its subcontractors for fast and sizable expansion.

To accomplish this the division prepared a series of "M-R Plans," which covered several different expansion programs. These representatives went to each of the subcontractors and, in effect, said "What will you have to do, what will you require in the way of (Data to page 316)



Large-scale production of the People's Liberty P-40 Courier shipboard fighter, one of the aircraft in the world has been actually aided by extensive subcontracting with parts and subcontractors making the final production line from widely scattered parts of the country.



Are you interested in:
 (1) Reducing time and cost of handling tools and materials;
 (2) Saving floor space;
 (3) Increasing production against fire, sabotage and personal injury hazards?

This comprehensive catalog contains many suggestions for meeting these war-time problems. It illustrates and describes many types and sizes of shop boxes, work benches, portable tool stands and many other items that manufacturers of Airplanes and Airplane Parts are finding most effective in every production operation.

Mail coupon today for your copy of this useful book.

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LYON Service

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A Salute to Our Employees and to Our Suppliers

As an "AWARD FOR EXCELLENCE" the Army and Navy of the United States of America have given us their highest honor—the Army-Navy "E." With grateful appreciation we acknowledge the debt to our suppliers for their tireless energy and efficient cooperation and to our employees whose faithful work and loyalty have made it possible for us to achieve this signal honor. One of the first 107 companies in the United States to receive this award we are indeed proud to have a part in the great united war production program. Materials of war are being shipped from our plant at the rate of over one hundred carloads per month at present. We hope to do still better tomorrow.

WEBER
SHOWCASE & FIXTURE CO. INC.
LOS ANGELES, CALIFORNIA

Mens and Machinery Available for War Work

Containing its complete range of information serves to both prime and educate. Advance payments are made and machinery available for war production work. Address requests to American, 300 W. 42nd St., New York.

125 As Indian machine tool manufacturer has specialized machine equipment available for manufacturing work. Any general type of cylindrical grinding work is desired up to 18 in. dia by 4 ft. long, maximum work up to 2 to 24 in. dia by 4 to 2 ft. long. Some types of flat finish work can also be readily handled.

127 A Wisconsin post, whose war-time expenditures average more than 14 years experience, has some 12,000 man-hours per week available, of which 40 percent are held as highly skilled; 34 percent skilled, and 19 percent semi-skilled. Skilled working divisions are 300 lathes, 120 drill presses, 8 shapers, 4 planers, 14 milling machines, 27 punch presses, 5 foot presses, 2 automatic screw machines, 2 internal and 2 external grinders, 2 die cast machines, 2 bending bars, and a lot of milling and cutting machines, grinding, polishing and buffing equipment, brooders, sheeting presses and bending hinders. The woodworking division has drill presses, band, pg. sander, sand, universal and filing other saws; shapers, lathes, routers, angle and belt sanders, single and double spindle boring machines, planers, routers and a lathe. Chemical division has produced special alloys, disinfectants, compound solutions, soldering fluxes and leather treating solutions. Equipment includes machines capable of from 2 to 600 gal. capacity; stiles, filter presses, debossing tanks and vacuum equipment. The organization has a contractor in stock in clearing work and taking up no job.

128 Oklahoma oil and gas tooling instrument manufacturer, now doing aircraft subassembly work, has additional

facilities to put in stock. Equipment includes 30, 11 and 12-in. meter belts; 0-600 in. teleview, a No. 2 dynamo; turn lathe, 8-90 in. teleview, 30 and 24-in. drill presses; horizontal milling machines; 11 in. pipe bending machines; band and pg. saws.

129 Ohio publishing and printing organization, now working for aircraft producers, offers template making facilities for aircraft manufacturers and subcontractors. Work is done in template department, segregated from plant proper. Templates made of 18 or 16 pipe, made body, straight-lined steel, engraving, photo-etch or master ton.

SKILL AND EXPERIENCE

SPECIALISTS in performing real shaping aircraft plywood from flat stock.

**PLYWOOD ANGLES
PLYWOOD CHANNELS
PLYWOOD TUBING**

A CAPABLE ORGANIZATION
with ample capacity to meet your requirements promptly.

Send us your blueprints and specifications.

WRITE OR WRITE TODAY.

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FIXTURE MFG. COMPANY
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Plywood and Wood Parts

Specialist



**Designers & Manufacturers of
MANIFOLD EXHAUST SYSTEMS**

and manifolds, mufflers, for motors, motorcycles, gas engines and other oil burning street vehicles of various capacities for best price work there.

AIRCRAFT COMPONENTS, INC.

WAX MILLS, CALIF.
WINTER, KANSAS

Quality . . . Delivered 'On Schedule'

Aircraft parts, manufactured for assembly into this nation's aerial war craft, must be "made right" . . . and delivered "on schedule." There can be no compromise with either element.

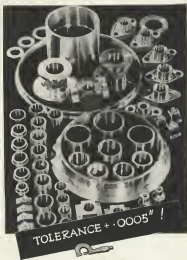
Before Pearl Harbor, Aircraft Mechanics, Inc., was fashioning vital aircraft forgings and welded assemblies . . . as subcontractors for most of the major airplane manufacturers.

Since December 7th of last year, we have tripled in numbers of workers, and have extended our operations into floor space four times as large as that previously used—yet, we have maintained the quality of our workmanship and deliver "on schedule" . . . sometimes even in advance of customers' expectations!

Quality . . . delivered on schedule!

**AIRCRAFT MECHANICS
INC.**

Colorado Springs Colorado



TOLERANCE + .0005"!

Precision-machined parts in special sizes for special purposes

You can't buy one-of-a-kind metal parts like these on the open market. Each one is special in size—for a special purpose—and machined to extremely close tolerances.

We have just produced 35,000 of these parts right from the drawings . . . cast them in our one-of-a-kind foundry from brass, steel, copper and aluminum . . . machined them in our precision machine shop and heat and repaired delivery schedule! Through multiple production methods we can turn such parts out fast—and deliver them fast! They're off—and of our plant now—going into aircraft, ships and other vital war equipment.

Production Managers:
If you are purchasing closely machined nonferrous metal parts or assemblies—and then delivered on schedule to fit your own assembly—fill out this form and mail it to us. We'll write or wire.

KIRSTEN PIPE COMPANY

Box 1011 or 1012 Western Avenue
Seattle, Washington

Circle 100 on Reader Service Card
Quality Production, Delivery and Service
Machine Products



4 AT GOOD DEALERS EVERYWHERE

plates applied by explosion. Machines are 24 by 48 in., tolerance 0.005 plus or minus. Has special equipment to handle plate metal up to 6 by 14 ft.

130 Perry says old New Jersey yard of Starr, James and Special Equipment Co. element, metallurgical and allied process industries with 300 workers, mostly skilled mechanics, now doing some aircraft subcontracting, also now work. Formerly can produce about 25 tons of cast iron, 2 tons of brass, and a few tons of lead and aluminum casting per 8-hr shift. Machine shop equipment includes two engine lathes with diam 31 to 25 in. range, tolerances 0.001 to 0.005, two 30 in. turret lathes, tolerances 0.001, three saddle lathe machines, two of 30 in. and one of 0.005 tolerances, five boring machines, 0.002 tolerances; eight drilling machines, seven of 0.002 tolerances, shapers, grinders, cutters, lathe-motors and feeding equipment and welding machines.

110 New York State Specialty concern now doing aircraft work has the following equipment: 26 power stamping and blanking punch presses, 300, 500 and 800-ton size presses, 200, 300, 500, and 800-ton drop hammers; 4 Union mechanical pantograph engraving machines, 124 light, medium and heavy tool presses, 13 hand screw presses; 13 spinning machines; and 4 hydraulic presses.

Stamping & Gaskets

SMALL TOUGH JOBS..

Typical small parts produced:

Long presses for materials from .005" to about 1/16" thick, maximum draw up approximately 4" and blank diameters 8". For those opening 10-100 to 100-1000 small cap screws. All types of material. G. O. G. specializes in the production of stamped, drawn and formed metal parts ranging from .005" to 1/16" and thicknesses using all type metals and alloys. Lowest prices.

G. O. G.

METAL STAMPINGS, Inc.

Division of THE G. O. G. CO., INC.

Machine Shop, 1000 10th St., BOSTON, MASS.

Launching THE AIR AGE

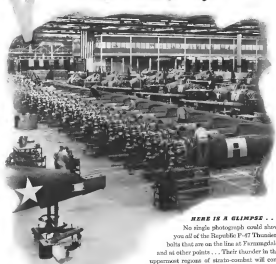


The great ships of the air, succeeding ocean liners down the launching ways, will ply the boundless ocean of space—crossing land and sea to carry cargoes directly to port of destination on the fastest ton-mile basis. Such huge transports rely on power by Wright.

WRIGHT Aircraft Engines
POWER THE TONNAGE OF THE AIR



**OLUME
FOR VICTORY**



HERE IS A GLIMPSE . . .

No single photograph could show you all of the Republic P-47 Thunderbolts that are on the line at Farmingdale and at other points . . . Their thunder in the uppermost regions of strato-combat will contribute mightily in the crescendo of victory.

REPUBLIC AVIATION

REPUBLIC AVIATION CORPORATION



FARMINGDALE, L. I., NEW YORK



**Guardians
Of the
Convoys**

A convoy leader with what war naturally plans toward its defense lies under the protective eye of a Navy blimp ship armed with bombs, depth charges and guns against Axis submarines. Blimps can

ascend close to the surface of the water, making them effective even on ships of low sailing and limited visibility, a factor which it is obtained makes them superior to surveillance-air craft for convoying.

Lighter-than-air branch of naval coastal patrol service taking a larger part in keeping sea lanes open for movement of men and materials to battlefronts.

By ESTER H. FORBES

LONG CONSIDERED BY the public as useful only for sight-seeing and advertising purposes, blimps are regularly coming into their own as military weapons. Day after day they are patrolling both Atlantic and Pacific coasts to assure delivery of valuable cargoes, including the birth placed in them by a small group of naval aviators.

One of the most battles fought in the United States in this war is the battle of transportation—transportation to our Allies, to our own fighting forces abroad, and between ports along our coast lines. An efficient enemy exists between North America and England had been established before Pearl Harbor. Since then one of the most pressing problems

has been speedy transportation of men and material to our distant outposts. This the aviators are accomplishing under direction of the Army's Air Transport Command. When, in the middle of January, Axis submarines began their prying on our overseas shipping, we were faced with a third problem of transportation.

We were unprepared for the sub attacks because we had been concentrating on the important job of keeping open our lines to England. Enemy submarines exact ship and Army and Navy planes was at that time needed more elsewhere. And so, month after month, merchant ships were sunk off the Atlantic coast, in the Gulf of Mexico, in the Caribbean, off South America, and off the Pacific coast with no apparent end in view.

The Army and Navy, however, were

taking steps to protect American shipping and shortly putting them into effect. They were gathering in old American and British destroyers and destroyers. There were important pleasure yachts and fishing ships, receiving a few British tenders with their crews, getting old and new minesweepers, surveying ships, art tugboats and Coast Guard cutters. They were organizing patrol squadrons of Army, Navy and Coast Air Patrol units. Finally, the Navy began its great delivery of 48 K type blimps which it had ordered from Goodyear some months before.

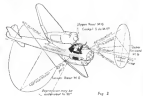
To intercept these surface and air units patrolling the Atlantic coast, a new branch of the Navy was created—the Eastern Sea Frontier, commanded by Adm. Adolphus Andrews. Each unit is responsible to the commander of its base,

Arrangement and areas of protective fire screen show vulnerable points.

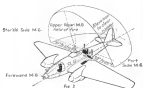
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The 2C-80 (Pipes 1 and 2) is still the largest river in the basin, discharging 100 m³ of water per second, and is the most important source of water for the city. The 2C-80 is a tributary of the 2C-80, and is the most important source of water for the city. The 2C-80 is a tributary of the 2C-80, and is the most important source of water for the city.

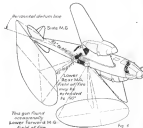
Fig. 1



Page 1



Page 10



Page 10



The *Megachile* MP 573 (Figs. 6 and 7) is very large (bigger in all around) forward, but is right in both size and shape for genus and size. Pronotum five pairs consists of four 7.0 number pairs and two 20.00 small pairs, all close to one third position. (Also see page 58.) Side protection from the side is from one 7.0 which can be strong but 40 deg. to yellow side, up 60 deg. above horizontal and to 10 deg. below. With a white wing at 22,000 ft., the phase can a top speed of 340 mph at 22,000 ft., and cruises at 260 mph at 16,000

The JG 67b (Fig. 6), the still widely used 300-lb., has been proved to be extremely vulnerable without incorporation of any special armor. Its forward fire power consists of two T38mm machine guns in the wings, firing outside the propellers and Protection from the rear depends on one T9 which can be swung only 30 deg. to either side, 45 deg. above horizontal and a little less below horizontal.

At the same time—the 28-year shell game as well as the 79s—must be swung by hand, for the Greens have done almost nothing with power turbines.

¹ For other numerical and source details see ARISTARCH, August 1942, page 108.

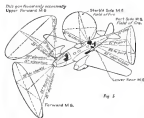


Fig. 1

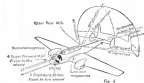


Fig. 1

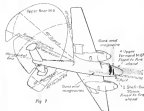
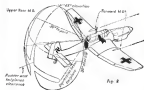


Fig.



Res.

BE READY FOR WINTER'S ATTACK

INSPECT AND EQUIP YOUR FWD's NOW... FOR FAST LOW-COST AIRPORT SNOW CLEARING



hundreds of FWD's, similar to this model, are now in use in business for the snow work—fitted with snowplow equipment and equipped ready to get the winter fighting done. After a busy day and summer on regular street maintenance work.

FWD

KEEPING 'EM IN THE BLUE

... Calls For Good Clear Runways Below ...

Keep 'em flying by giving 'em runways clear and clean of snow. At airports in every state in the snow belt and many Canadian provinces (where heavy snowfalls are a constant menace) FWD trucks are being made ready for snow clearing duty—a service in which they have earned and kept fast place.

In cooperation with the aims of the U. S. Truck Conservation Program, FWD has here a few practical suggestions to enable airport operators to get the most in performance with minimum maintenance out of their FWD snow removal trucks:

Conserve tires—snow removal truck operators are universally agreed that single tires are best in snow removal service. The use of single tires at the same size on all four wheels not only conserves rubber but also reduces excessive differential action, thus prolonging the life of the track. Closely spaced tire chains—not emergency chains—should be used on all four wheels, for maximum traction and least slippage and damage to tires.

Care of engine—change engine oil frequently enough based on total hours of operation. Keep cooling system clean and free of rust. Control engine temperature with a radiator hood or automatic shutoff.

Storing the truck—sub-zero temperatures make likelihood the still and cold, cause steels to become brittle. House all your trucks when not in use—avoid outdoor storage for longer truck life.

Inspect your trucks—periodically and check for needed replacements—take advantage of FWD's principle of progressive interchangeability of improvements and vital parts.

See Your FWD Branch or Dealer

The entire FWD organization of factory branches, FWD dealers, and district servicemen are all pledged to help you get the most out of your trucks by aiding your program of preventive maintenance. Call on them frequently for sound maintenance advice and skilled service.

THE FOUR WHEEL DRIVE AUTO COMPANY
CLINTONVILLE, WISCONSIN • Canadian Factory: Kitchener, Ont.

FWD HINTS FOR WINTER MAINTENANCE



1. Use single tires on all four wheels.



2. Use tire chains on all four wheels.



3. Use a radiator hood or automatic shutoff to control engine temperature.



4. Use a snowplow or other snow removal equipment.

5. Use a snowplow or other snow removal equipment.

FWD
TRUCKS

—THE FOREMOST TRUCK FOR FAST, LOW-COST AIRPORT SNOW CLEARING



THE FWD FOUR-WHEEL-DRIVE TRUCK PROVIDES SO MANY OUTSTANDING SNOW REMOVAL ADVANTAGES



AUTO BODIES TO AIRCRAFT

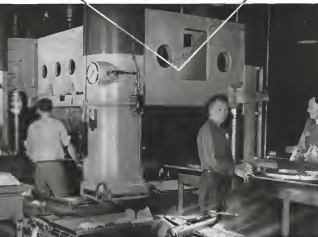
with **HPM**

The Munnay Corporation of America converted to Aircraft production with the aid of this modern 3300-ton H-P-M

PASTRAVERSE Press. It employs the Gairie rubber pad process of blanking and forming many dual parts at each operation. Loading tables, working in from all four sides, speed production . . . The exclusive H-P-M HYDRO-POWER Relief Pump and "Closed Circuit" operating system insure dependable performance every hour, day and night.

THE HYDRAULIC PRESS MFG. COMPANY, MOUNT GILEAD, OHIO, U. S. A.

Export Sales Offices: New York, Boston, Detroit and Chicago. Representatives: Ford City Corp.



Industry relies on **H-P-M HYDRAULIC PRESSES** to "keep 'em flying"

periphery members to crank setting. Likewise during the early running period will destroy the upper cylinder lubrication and pistons will result in scoring and scoring of rings and pistons—these things large quantities of oil are burned. In other words, adequate lubrication is not always indicated merely because the engine shows high oil consumption. Many factors, of course, can influence such conditions, but it will be apparent from this limited outline that the piston rings are critical to successful engine operation, even before the engine is ready to fly. A paper by Donald G. Kishel of the Wright Aeronautical Corporation, entitled Engineering Factors and Production Control, published in the May, 1940, issue of the *NAA Journal* deals in part with piston ring setting and oil control, and is recommended for those particularly interested in this subject.

Replacing Rings at Overhaul

The procedure to be followed when installing new piston rings is as follows:

engine at the time of overhaul varies with different engines. It is strongly urged that in all cases reference be made to the overhaul manual published by the engine builder. The data given in these manuals is the result of long experience with each particular engine, and optimum results will be obtained by following the instructions given therein. It may, however, be desirable to check briefly the ring setting work on a 15-hp Pratt & Whitney Twin Wasp engine of 3,000 lbs. thrust, though attention is called to the fact that the data shown is given in most complete form in the Pratt & Whitney overhaul manual.

Cylinder Reconditioning

In most cases a cylinder is considered suitable for re-use if the wear has not exceeded 0.000 in. on the diameter. As to the amount of lapping and oil-scumming, it is generally recommended that each of these work be held to a maximum limit of 0.005 in. in order to consider the cylinder suitable for re-ringing. If any of the measurements



show greater than 0.005 in., indicating to over-size or not cylinders are recommended. Reconditioning of existing barrels is not recommended. The top or ridge running from wear at the cylinder in the top of the piston ring track, can be removed simply by using a hand stone or by means of a small portable grinder. When this operation is carried out, care must be taken not to grind beyond the upper end of the top ring travel, and it is important that the surface be blended to the adjacent part of the cylinder wall as perfectly as possible. Unless the ridge is properly blended or removed, ring leakage of the new top ring is apt to occur.

The barrels on this particular engine have a "taper" of 0.015/0.018 in. at each end of the stroke. Lead of the cylinder head and extending approximately 2 1/2 in. up the cylinder barrel. This ridge feature provides a straight cylinder at normal engine operating temperatures. If the cylinders are removed straight, (Turn to page 202)



END GAP	SIDE CLEARANCE
A 0.0095-0.0095	0.003-0.005
B 0.0085-0.0085	0.004-0.007
C 0.0085-0.0085	0.003-0.005

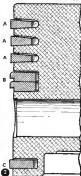
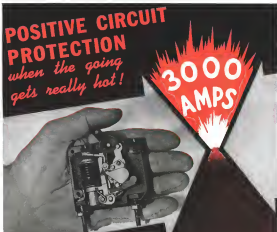


FIG. 1. Typical piston and piston ring setup and in last step, piston rings. The piston contains the ring design shown in cross-section form in Fig. 1. . . **FIG. 2.** Cross view of 15-hp (overhaul) engine piston ring showing recommended side and gap clearance. The hand gauge reaching the slot of ring and the bottom gauge with the plan compass slot are deflected to show excess of the workpiece . . . **FIG. 3.** Piston ring has been set. The ring is checked dimensionally by the specified gap clearance, and the lead required is indicated by the spring scale . . . **FIG. 4.** Closing gap for lead and clearance. This gap is made by cylinder diameter and the clearance between the web dimensions by means of lapping. If the gap is filled with sufficient lead and clearance, lapping is likely to occur.



POSITIVE CIRCUIT PROTECTION
when the going gets really hot!

3000 AMPS




CIRCUIT BREAKERS for AIRCRAFT

While the normal operating capacity of this fully electro-magnetic breaker ranges up to 50 amperes at 24 volts DC it has withstood several dozen short circuits at 3000 amperes without suffering damage or affecting its efficiency for further use. Heinemann Aircraft Magnetic Circuit Breaker answers the demand for effective protection of light, radio, motor and control circuits under today's severe wartime flight conditions.


HEINEMANN CIRCUIT BREAKER CO.
 Subsidiary of Rohmann Electric Co. Established 1898
 TRENTON, NEW JERSEY


Vibration proof and shock resisting
Operates in temperatures from -50° to 200° F.
Opens instantly on short circuits but delayed trip permits harmless overloads


PROGRESS



**THE NEW PUROLATOR
 PA-12 AIR FILTER FOR
 VACUUM OPERATED INSTRUMENTS**

40% Lighter


35% Smaller


50% Efficiency


The new Purolator PA-12 is a decided advance in low resistance air filter design over the previous model PA-11 with which it is compared above. The reduction in size and increase in design efficiency are accompanied by a new application of Purolator's patented area design... in Purolator's patented plastic impregnated wood cellulose filter elements. Tests prove the new PA-12 removes solids down to three microns from air... even at temperatures of minus 68°F. and plus 160°F.

A catalog showing complete details of current Purolator circuit filters for air, lubricating oil and hydraulic oil is available to responsible officials on request. These filters are equipment on fighting planes produced by standard American manufacturers.

Purolator places at your disposal for consultation and experimental development work its staff of ex-

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**KEEP 'EM FLYING LONGER
 with
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 California Office: 1401 South Hope Street, Los Angeles
Franchise, Dealer and Lessor of the Filter Industry



Yes

HERS IS A SERVICE UNIFORM, TOO

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Ball bearings are used by the millions in planes and tanks and jeeps and guns and ships... in war machines of all kinds, wherever shafts turn. And in the machines of industry making the machines of war. Indeed in this highly mechanized mobile war "rolling rolls like a ball!" has you rolling?

Yes, the smart woman for the New Departure girl in a service uniform... New Departure Division General Motors Corporation, Bristol, Conn., Chicago and Detroit.



According to the boys' demand for improvement, New Departure research engineers are giving new engineering knowledge and design and application for the benefit of all mankind when they produce...

MEN AND WOMEN OF

New Departure



DOUBLE OUR PRODUCTION AGAIN?

Hell yes!

WE CAN HELP YOU WITH YOURS

The complete facilities of our plants, fully equipped with highly skilled men are at your disposal. Today we are engaged in making heat transfer components and such war equipment as aircraft tanks, aircraft and marine heaters and other confidential items.

We are also helping other manufacturers meet their war production schedules. We can help you, too! Write, wire, or phone for full information. McQuay, Inc., 1624 Broadway Street, N.E., Minneapolis, Minn. Representatives in all principal cities.

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Our facilities include complete plant and tool room equipment for fabricating, welding, cleaning, painting, machining steel, copper, aluminum, special alloys as well as modern plywood parts and units.



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MARINE VENTILATING PRE-HEATER



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MARINE VENTILATING RE-HEATER



AIRCRAFT HEATING SECTION

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When the need arises for a metal cutting tool to do a **SPECIAL** type of work—make it a rule to call Motor Tool.

Motor Tool is an organization of trained experts in this highly specialized field—concentrating on the development of **SPECIAL** metal cutting tools.

No matter what your requirement—how unusual the metal cutting operation may be—you can completely rely on our ability to produce a tool that will do the job with accuracy and precision.

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METAL CUTTING TOOLS
7181 EASTLAND AVENUE - DETROIT, MICHIGAN

*Make it a Rule
to Call Motor Tool*



CARGO PLANES

Can Expand World Trade

A recognized authority on international commerce here analyzes the influences likely to be wrought in world trade by air transport. The author presents some surprising figures on savings through reductions in intermediary costs as compared with surface shipping.



The modern airplane has the impact upon development and expansion of air transport by the nations of our nation for it is a new rule in international commerce after the war.

By **GEORGE F. BAUER**
International Trade Commission

WILL WORLD TRADE depend principally upon airplane transport after the war? Are most of our products going to be sent to other lands by cargo plane and still we receive by the same kind of transportation many of the material things that other nations throughout the globe have to offer us?

A review of the fundamentals which underlie international commerce, particularly those which may be affected by

air transportation, will give us guidelines toward the answer.

First of all, what is international trade? Is it very much different from domestic business? If it was not for language and man-made boundaries of nations, we would find these differences to be similar to those among us in trade at the stores of various of our States with the people of other States. In both foreign and domestic trade, people of one nation offer their products and hope to obtain the goods of people in another nation; in domestic trade the services are in the same country, in world com-

merce they are in different nations.

The more that goods can be exchanged by one group for the largest possible supply of products of another, the more there is to go around of all kinds of goods for the utilizing of all.

Thus passengers that are offering the exchanges of goods, the offering of an intermediary nature for handling, financing, transportation, supervision and distribution are kept within reasonable bounds.

If airplane transport of persons or goods tends to decrease these intermediary costs in international trade, to what

degrees will it be released as a most helpful agency in advancing the standards of living in terms of abundance of goods for people everywhere?

Under the agricultural system, increases in volume of sales abroad are dependent on the same conditions recently found here. A large demand for any product can best be developed through a decrease in the cost to the public. After the war, the assumption will be that any increase must be that you greatly increase the number of sales as you bring down the cost of the product to final consumers.

In international trade there is a great difference between what a producer receives for his goods and what the final user pays. Intermediary charges enter

In export intermediation, the airplane already has delicately provided vast resources for the American business man desiring to extend his markets abroad. Formerly no extensive outlet to vast distributions in Argentina had to ferry 15 days on a steamer New York. By shore up plane in about four days for the manufacturer standing here, there is a saving in the safety of an steamer for a period of two weeks. Expenses for actual accommodations by air or steamer are very little apart. Through the airplane, the development of overseas markets has consequently become a decidedly less costly undertaking than in the olden days.

This theory of sales promotion expands as result of smaller total travel



and. Aircraft can travel over the oceans of the world at 250 mi. an hour—compared to the desperately slow pace of 18 mi. an hour that your average freight ship has to go at.

What does this advantage of speed by the air cargo plane mean in terms of intermediary costs of goods at world trade?

The saving in interest charges will look as a most important one from an international viewpoint. Goods on the oceans of the world, if shipped by cargo airplanes, would require only 1/25 of the time now needed to arrive at their destination. Money represented by these products would consequently only be tied up for 1/25 of the present time now involved in the shipping period.

Normally the export and import trade of the United States may be estimated at \$500,000,000 a month. The interest charges, if conservatively calculated, would amount to 3 percent, but for every country on the high seas there is at least a like quantity in inventory carrying another 3 percent interest charge.

The monthly foreign trade of the United States is consequently subjected as result of air traffic delays to an interest charge of 3 per cent on \$500,000,000 or \$5,000,000 monthly, or \$60,000,000 a year. With cargo airplanes the time tied up in shipments and intermediation could be cut to 1/25 of the time now required. The interest charge would be cut to \$5,000,000. This one item would make as annual saving on our foreign trade of more than \$50,000,000 and accordingly permit acquisition of additional real goods by that amount by our foreign customers and us.

Actually, the time saving factor will also apply during periods that goods are shipped from the interior to seaboard and from the foreign country to the interior of the foreign country. This time saving may be estimated at half of the period involved in the case where by freighter an against cargo plane, or in terms of added interest savings, \$45,000,000 a year.

The time factor, then, from the cargo plane as against the freighter when related to interest charges on goods tied up in cargo or in inventory.

What about the direct cost factor? According to Mr. Looney, "Accordingly arguments can be shipped on a modern freight vessel at less than 10 a ton mile. It appears equally evident that with the



Two cargo ships arrive at Lima

Throughput of air-cargo ships will become the frequent as products will go forward from centers of production to places of buyers with less intermediation handling, unloading and rehandling.

heavily into the calculations. It is not infrequent that goods selling at retail in a producing point in the United States for \$200, have to be sold in terms that amount to about \$2000.

The intermediary costs so fearful in loading the planes in foreign buyers result from charges for export boxing, inland railway charges, lighters, and the fact of inland, ocean freight, insurance, consular fees, duties, port and transport charges, financing, rehandling and distribution.

It is in this area between the prime profit to the producer and the prime cost paid to the foreign buyer that air transport already has acquired great importance and will increase even more.

costs, including railway charges, transportation, hotels and food, can be passed on to final buyers abroad. This cost development tends to bring goods of all kinds to buyers in great numbers of people everywhere.

Actual transportation of goods by airplanes was already well developed before the war started. Shipments of aviators to distributors in various parts of the world were not unusual, but after the war, with the great advances in air cargo ships, they will multiply rapidly.

In an address before the Foreign Commerce Club of New York a while ago, Governor Looney stated that the "air method of shipping is no less than 25 times as fast as what is now



Ready..Willing and Able

THOUSANDS of Kinner Engines are on the line, ready night and day to serve the Army, Navy and the C. P. T. P., in their ceaseless job of primary training.

And this performance is matched by the production ability of the men and women who build Kinner Engines. From the factory to the flying fields Kinner...and Kinner Engines are ready, willing and able!

KINNER



KINNER MOTORS, INC., GLENDALE, CALIFORNIA

... On Alert!

From Alaska to the steaming tropics American fighting planes, by increasing thousands, are "on alert"—ready and highly competent to beat the enemy at his own game.

Ready, too, as an integral part of these airplanes are the hydraulic controls by Bendix Aviation, Ltd., which make up one part of the Invisible Crew that is flying aboard virtually every fighting plane built in the United States.

On the Lockheed P-38, for example, are a number of Bendix Aviation, Ltd., hydraulic units—each one built to the Bendix standard—designed for production as well as for performance.

CONTINUOUS-SHELL ACCUMULATORS

Latest achievement of Bendix Aviation, Ltd., engineers is this continuous-shell hydraulic accumulator, already installed on several of America's new, powerful fighters. Since its introduction it is lighter, stronger, more rugged and more reliable than any other hydraulic accumulator. The "I" and "C" are now being given this production release date during 1943 and Bendix has the capacity to 50,000 per year.

BENDIX AVIATION, LTD. HYDRAULIC EQUIPMENT

BENDIX *North's Hollywood*
SUCCESSION OF BENDIS AVIATION CORPORATION



ONE PART OF THE
INVISIBLE CREW

Bendix
HYDRAULIC EQUIPMENT



of glides and new developments in properly transmittable air units will run about 50, a 500 mile.

Obtained a look at the direct and indirect flow of the Douglas as against the cargo plane.

During recent years very fundamental changes occurred in the methods of constructing longer trails. Packed goods have been used almost in decreasing quantities whereas the tendency to send parts and components for assembling in place abroad has increased. Certain economies in freight space requirements, loading and shipping charges have been the reason, but transmittable air cargo plane.

With freighters there has been difficulty in adapting the cargo to the ship. In most instances it was absolutely required to prepare the cargo to fit in with the limitations of a freighter.

There was another, for example, in proper loading of goods, a requirement quite understandable from the viewpoint of the ship's operator and yet most easily from that of the final buyer abroad. The claim was made that facilities in foreign ports were inadequate and that the cargo would be spoiled as less fully protected by lashing. Nevertheless, there were instances when a mere shipping had resulted in no increase of 13 percent in the cost of the goods it contained. It was not the cost of the container as such, but rather the pyramidal charges assessed on it with freight on a weight basis, customs duties and internal taxes on the increased cost, that brought about this situation.

During a one hour that should be capable of great modification, when not entirely eliminated, in shipments by cargo planes. Wrapping, too, may not require the same expenditure as when goods are under way a long time on the sea.

However, one of the extraordinary cost factors may also be formerly affected by air transport. Need for transshipment under trying conditions in many expedited of harbors will diminish and thereby reduce breakage—an important component in decreasing expenses rate.

Transshipment, themselves, may become less frequently necessary as goods will go forward from sources of production in places of buyers without cost of extensive handling from foreign into railway freight cars, onto lighters, or into lighters, trucks and steamships with consequent unloading at destination, and then again, onto parts and into



The American Airline plane

Getting and customer needs for air transport is most cases will be simpler and lighter than those required for ocean shipping. Many cargo can be reduced to reduced weight and cost.

larger freight loads and final delivery by truck to the overseas market. These operations can be most easily and most advantageously done in the present past to overseas customers, their elimination or reduction will be a factor favoring air cargo planes.

Comparison of separate trials to make for better results for warehouse in which to store goods pending destination comes to a distribution in major parts of a country. With leading fields realized over a wide area and goods brought closer within reach of the markets who anchored them, the elements of congestion diminish and local facilities with their more reasonable results can be brought into use. In some cases, the loadings of local warehouses can become handled themselves thereby saving additional savings that always follow when congestion is avoided as happens when parts no longer become backwaters of delay.

Good transport means, possibly, belonging to mankind, themselves are to be utilized and the expenditure for living

of such reduction of parts with high operation costs avoided.

All of these extraordinary charges, when presented on individual products become considerable and, if their result is to gradually work possible in cargo planes, the instance to them from present methods of transportation will be impossible.

In the trade among individuals, the speed factor definitely favors air cargo ships, the transmittable cost factor works (Page 260)



AVIATION November 1942

"B" Braid Synthetic Construction

... SAVES WEIGHT
... SAVES SPACE
... INCREASES ABRASION RESISTANCE

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In its 26 great manufacturing divisions, Auto-Lite is producing for America's Armed Forces on land, sea and in the air.

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SUNNEN *Precision* HONING

**For INTERNAL DIAMETERS
of .185" to 2.400"**

Small • Inexpensive
Economical • Greater Accuracy
• Super-Smooth Finish

Tool engineers — sub-contractors — tool and die shops, as well as hundreds of leading prime contractors, are spending up production and cutting costs with this practical honing machine.

Accuracy within .0001" guaranteed — produces super-smooth finish. Corrects errors of out-of-roundness or taper caused by previous operations. Maintains alignment. Facilitates duplication of sizes. Can be set up and work located in a minute. Does not require skilled labor. Relieves big internal grinders for other jobs.

SUNNEN PRODUCTS COMPANY
7942 Manchester Avenue St. Louis, Missouri

Canadian Factory, Chatham, Ontario

SUNNEN



Make 1 machine do the work of 2

New WILSON "HONEY BEE" ARC CONTROL STATION permits 2 or more welding operations from one WILSON "HORNET" GENERATOR



One Wilson "Hornet" supplies two or more times more production when used with the new Wilson "Honey Bee" Arc Control Station. Two or more welding operators are performed simultaneously by connecting three 75 ampere Wilson "Honey Bees" to a 200 ampere Wilson "Hornet", or four 75 ampere "Honey Bees" to a 300 ampere "Hornet". More arcs per generator are provided with a better load factor and more welding per K.W.H. of power purchased.

Wilson Arc Control Stations are made in two sizes, 75 ampere and 150 ampere for use with any constant potential arc welding generator. Any Wilson "Hornet" can be

changed to constant potential by making a simple connection.

A control switch which may be combined with the electrode holder permits the operator to regulate his welding current from maximum to minimum without breaking the arc or affecting other station current settings. By gradually reducing the current the operator can avoid cracks, especially important for light gauge metal welding.

	DIMENSIONS			
	Height	Length	Width	Weight
75 ampere	20"	24 1/2"	15 1/2"	125 lbs.
150 ampere	30"	39 1/2"	19 1/2"	140 lbs.

For more complete information send for Bulletin AOW-47



Photo courtesy of Republic Aviation Corporation.

WILSON WELDER AND METALS

General Offices: 60 East 42nd Street, New York, N. Y.

CO., INC.

CONSERVE WELDING ELECTRODES

Write for free copies of this helpful booklet. It contains six shop bulletin emphasizing important ways to prevent electrode waste.



The Birdmen's Perch



THE NAMES FOR OUR Canary Club members were wonderful, right?

We wish we had a dozen Oily Boulds so that we could call them "Boulder-bird," "Oily Wing Lion" and "Boulder-bird."

And even Oily bawled as "Lather-ner" and "PB 5."

He didn't seem to like "Gauldier" or "Boulder-bird" or "Armenian"—but we did.

But the life-size portrait of Oily goes on, right? Merry Boulders, English-



wood, N.E. sent in the same we liked most, the name that most perfectly describes our G-F Ford.

Fresh Pinks, now "FLUTTER," the Oily Bird.

Major Al Williams
alias, "Lather Wing Top,"
Gulf Aviation Products, Inc.,
Gulf Wing, Pittsburgh, Pa.

BEADWISER

A pilot had to fly from Pittsburgh to Detroit on business. He left home in the morning accompanied by his wife who

was him off and waved at the airport until he was out of sight. He flew to Detroit non-stop, and the first person to greet him was his wife. She'd not even

called by name, road, or plane. How did she get so Detroit?

When you send your post card for the answer, send us your brain-tingler. Complete with answer please.

SOME-DIAL

You Paul Pinks who fly over-engine jobs will soon find it much easier to check your instruments.

A new redesigning of an instrument combines the readings of three instruments (tachometer and a tachometer) on one dial. You get an eye reading on BOTH engines and see how much out of synchronization they may be at a glance. Reducing the two unnecessary dial depots of deadweight, and the remaining dial does more work.

Laborious reform by old-fashioned methods had parts which made sludges and parts which formed carbon on addition to the part which did the actual job.



Looking up the grid of these unnecessary parts of precision, Gulf engineers devised the **Richer Process**, which converts any of these old designs from Gulf.

price. And the meaning of oil does more work.

Better try it.

POWER OF THE PRESS DEPT.

It's been some time since we felt obliged to open the many doors of our POUT Dept.

But we'd like to remind you of a letter from "Gust Circle" Gabbins, in July's Dutch Post of his whisper said, "A whole lot of you mentioned a tailfin plane without a fuselage. It seemed like the wrong approach to a tail fin. It was a head in a tail fin to drag. I said to me the problem of drag in a different way. I made a tailfin plane without a wing."



New and this, from a recent newspaper:

"A wingless airplane dubbed the **Thru Flounder** has been successfully flown more than 50 times by an inventor. The plane looks like an airplane and does 150 mph."

Well—

But he used Gulf Aviation Gasoline, too.

Gulf Oil Corporation and Gulf Refining Company...makers of



Oil is ammunition—USE IT WISELY!



DoAll HELPS WRIGHT keep tonnage flying



• This model ML DoAll installed in a tool room in a plant of the Wright Aeronautical Corporation, is one of many DoAlls helping to build Cyclone and Whirlwind aircraft engines for the United Nations.

Today Wright Cyclones and Whirlwinds power planes and tanks in combat and power troop transport and cargo carriers which now fly to war fronts all over the world. Tomorrow, as the tonnage loads of commerce take to the air, Wright engines will provide the power.

SPEEDS UP PRECISION METAL CUTTING

The DoAll is doing a real job in busy plants everywhere—replacing slow methods of shape cutting any kind of metal or alloy, blocks a foot or more thick, bar and sheet stock, tubing.



and ON THE GROUND

The DoAll is part of the essential equipment of each mobile machine shop of the U. S. Air Corps used for servicing combat planes right on the spot.

DOUBLES MAN-HOUR OUTPUT

That's what this master machine tool is doing for the aviation industry. Look over jobs that are going through too slowly, waiting for shapes, muller or laths. Whenever there is internal or external cutting or filing to be done, switch the work to the DoAll and you'll be surprised at the time, labor and metal you can save.

Ask for Demonstration in your Own Plant

A factory trained man will gladly call and show you the many advantages of the DoAll which is offered in 5 different models ranging in price from \$1,000 to \$5,000 complete with motors.



FREE BOOK—"DoAll as Production", a practical story of DoAll work in many industries. Send for copy.

CONTINENTAL MACHINES, INC.
1385 SOUTH WASHINGTON AVE. • MINNEAPOLIS, MINNESOTA

Associated with the Gulf Company, Inc. Planning Division
Manufacturers of Road Graders and Road Film for Road Construction



Page 4

Page 3

Page 8

HIGH PRICED LIVES
and
HIGH PRICED SHIPS

POSITIVELY
**THIS WINTER
PROTECTION!**



SNOGO
*For Complete
Snow
Removal*

FOR years commercial flying has gone on taking "business chances" on snow in spite of the fact that adequate snow removal equipment was available. Commercial flying has been willing to risk business loss due to snow grounded ships, not knowing in many cases what snow has cost them. The Military Services have appreciated the fact that high priced lives and high priced ships deserve proper winter protection. Military airports are SNOGO protected.

Some day a peace treaty is going to be signed and commercial and private flying is coming into its own, and inability to meet transport schedules because the runway is littered with snow isn't going to be considered good business.

Thoroughly modern flying fields will advance the cause of flying by being SNOGO equipped.
Remember, SNOGO means winter flying safer. It throws the snow off the runway. No banks are built up to drift back on the runways or endanger wing tips. There is no costly repeat plowing. There is no heavy layer of packed snow to freeze into dangerous ruts or partially thaw into muddy spots and provide slush to be picked up in wheel potholes, freeze broken or be carried into wheel wells.

SNOGO has your insurance that winter schedules will be met. Aviation men and air-minded travelers should insist that airports have better winter protection.

**KLAUER
MANUFACTURING
COMPANY,
Dubuque,
Iowa**



It is seldom a field has drifted into this when you do, SNOGO can handle it.



Look at that throw! There isn't an bank piled up to cause trouble and drifting here.



It is sometimes desirable to window snow and then throw it into the unused area.

**POSITIVELY
GUARANTEED**
*to handle any snow
conditions that will ever
occur on any Airport!*

SNOGO *keeps 'em
flying in any
WINTER WEATHER!*



BURRING AND POLISHING METHODS

CUT COSTS

REDUCE REJECTIONS

INCREASE PRECISION



Burring is actually polishing, for polishing really means "removal of the surplus metal, plastic, or wood". Therein, lies the underlying reason why Leach Technicians have been able to help so many war industries with their burring operations. Leach Technicians have long been recognized throughout industry—metal and non-metal—as specialists in polishing, buffing and finishing in the removal of metal to provide decorative finishes. They are applying their knowledge and experience to burring problems.

The Leach Method of Burring cuts costs, reduces re-

jections, and increases precision. It does away with many costly and time-consuming operations calling for hand tools, emery cloth, or hand filing. Instead, it uses specially designed burs or wheels coated with the proper Leach Compositions.

Every day new burring—and polishing—problems are brought to our attention. With most of them, we have shown the manufacturer how to improve his operations. Send us your problem for our recommendations. If possible, send a sample of the work.

THE LEA MANUFACTURING CO.

WATERBURY, CONN.

Burring, Buffing and Polishing

Specialists in the Development of Precision Methods and Compositions

Wide range of problems can be handled by new devices but thorough understanding of basic principles is required.

Civil Operation and Training

Simplified Computers Aid Navigation



By LIEUT. CMDR. P. V. H. WEEMS

planes wind relative to the earth or its true speed and direction. $W \rightarrow P$ always denotes the plane's motion relative to the earth, or ground speed and track, and $W \rightarrow P$, the plane's motion relative to the wind, or airspeed and heading.

In using these to find out the velocity triangle it is extremely important not to reverse their order. For example, the heading and airspeed can only be $W \rightarrow P$ and not $P \rightarrow W$. The best practice is to work from the point W and establish an airspeed circle which in most cases is a known value. Now, with these principles in mind we can apply the solutions to flight computers. While most computers were in operation they are similar in operating principle. Their use is in direct proportion to the precision of construction and number of moving parts required.

The great majority of calculation consists of a series of circles plotted on a compass, under the one side of this usually is readily found the speed, true, distance, and fuel calculation. The most common form is that of a circular slide rule and an all-in-one is of such simple form as to be self-explanatory. It must always be remembered that the W mark on the true scale is the speed index. In conjunction with true speed and distance scale is also usually found an elapsed corrective. This, of course, is of great importance in correcting the indicated elapsed to true by taking the air temperature into consideration against the "pressure altitude".

The opposite side of the computer consists of the moving disks and plates required to solve the velocity triangle. Perhaps the simplest form of such

INDOCTRINATED new pilots, especially in the ground school sessions, is a problem that must be handled with common sense and common sense. In many of the branches there is a substitute for long hours of study but in some phases of air navigation recent developments have opened a number of ways to shorten the problem.

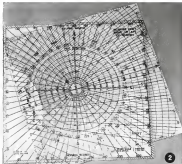
The same kind of problem, most of which can be handled on a flight computer, fall in this category.

Flight computers in themselves need not be considered complex or "magic boxes". The underlying principles can be thoughtfully mastered and the student must learn to recognize each problem type before setting it up on the computer's face. These principles, however, are not difficult if they are compared to a step-by-step procedure with the standard plane-table used in the service.

Every wind-velocity problem involving wind or drift is made up on a base figure called the velocity triangle. This triangle is made up of the values shown in Fig. 1. The descriptions R , W , and P are as follows:

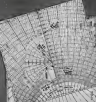
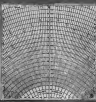
$R \rightarrow W$ = wind speed and direction
 $R \rightarrow P$ = ground speed and track
 $W \rightarrow P$ = airspeed and heading

The latter combination is self-explanatory in that R stands for earth, W for wind, and P for plane. $R \rightarrow W$ then an-



computer, yet one that embodies under the same principles and theory as the most precise computer used by the Army, is the recently developed Gilman Computer shown in Fig. 2.

This computer is especially adapted for training area analysis, because of its wide and well-distributed scales. It



has an extensive speed range and reads in every degree of drift and heading. It is also inexpensive—costing about one tenth as much as the Army model—primarily because of the lack of moving parts. (Fig. 3). Use of the Gilman Computer by Army ground vehicle or pre-flight classes will reduce many needed model fits to fighting phases.

To become familiar with the basic principles of all computers we can do so in better than thirty-five minutes from your Gilman Computer. It is composed of two plates A & B, as shown in Fig. 4, one movable on the other. Plate "A" can be rotated the heading scale, or wind grid, and Plate "B", the drift grid.

On Plate "A" the radial lines denote true direction for heading wind, heading or track. The concentric circles are wind velocity scales with the velocity shown along the North North and East West lines. There are two scales: 0-10, 100,000; knots, 1,000,000.

Plate B, as the drift grid, is a grid where the arcs are arcs of speed circles and the radial lines denote the degrees of drift from a point centered "off" the plate. The speed scales are arranged along the outer line in counter sense for each arc of the speed circles.

To use the computer two rules must be remembered.

1. When Track is known locate wind (on Plate A) in quadrant it is from.
2. When Heading is known locate wind in quadrant it is toward.

Remember also the old rule "add drift

right!" Set to go through a typical solution!

EXAMPLE 1: To Find Heading and Ground Speed for a given Track and Airspeed

Given: Wind, 38 mph from NW. Track to be made good, 75 deg (T). Airspeed, 150 mph.

(Note: Use black and green scales.)

Procedure: Locate wind in quadrant 3 in black scale in quadrant 3 in black scale from (see Plate 1 above) on 20-mph wind scale on NW bearing. Place Plate B on top of Plate A with course arrow (on the line of Plate B) through center of compass rose on Plate A and through 75 deg. (Track). Keeping plate thus aligned, move in or out until the 150 (A.S.) speed circle falls over the prescribed wind mark of Plate A. Now read 54 deg drift from the drift line through the same wind mark and read the ground speed at the center of the compass rose, 204 mph. The drift (41 deg.) is between the heading (drift line through wind) and the Track. Drift is always toward right or left of heading. In this case it is 41 deg right drift and is subtracted from track to obtain heading then, heading=75-41=34 (H).

Remember: Airspeed is always measured along heading. Ground speed is always measured along track.

A second example will serve to show the valuable type solution.

EXAMPLE 2: To Find Track and Ground Speed for a Given Heading and Airspeed

Given: Wind, 38 mph from NW. Heading, 220 deg (H). Airspeed, 185 mph.

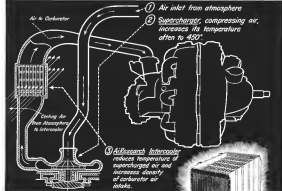
(Note: Use red scales.)

Procedure: Locate wind in quadrant 3 in black scale (see Plate 1 above). Wind circle 30 and course bearing 185 (A.S.). Place Plate B on Plate A with course arrow at the center of the compass rose. Now aim the wind dot read the speed circle 185 mph and the drift 34 deg. (Track). Track is then 254.

The computer is used to find velocity drift triangles. Rules of action, double drift problems, air versus sea, head, intercepting problems are all handled as the standard bearing.

While these problems involve complicated figuring beyond the scope of this article, they are basic drift velocity problems which use the same principle of solution as that at the origin of the discussion. Fundamentally, that is all that any computer consists of—simple velocity combination of the vectors in angle. It is in the solution of these problems that the set-up is its own particular strength.

UP goes the airplane's critical altitude...



AiResearch Intercoolers

help U. S. engines get more from their superchargers

The constant heat of supercharged air causes detonation, reduces engine efficiency. It decreases the weight of the mixture delivered to the engine—thus reducing the critical altitude of the power plant.

To improve the control of supercharged air temperature, our engi-

neers developed the AiResearch Intercooler. Thoroughly test-proven in AiResearch laboratories, these intercoolers are now in use in thousands of American airplanes, helping their power plants deliver added usable power at critical altitude.

The AiResearch Intercooler is vary-

light in weight. It is manufactured of heat-treated aluminum alloys. The entire assembly is sandblasted for protection against corrosion. Tubes are mechanically fastened and are pig-smeared to insure rigidity.

More than 30,000 hours of service have proven this intercooler's freedom from maintenance trouble.

AiResearch Intercoolers offer utmost flexibility. They are available in flathead or round tubular types. Tests of tube spacing and arrangements prove their adaptability to varied requirements of shape and size.

Aircraft manufacturers interested in the sub-steps of these intercoolers are invited to write or wire for details.



"Where Controlled Air Does The Job" • Engine Oil Cooling Systems • Engine Control Systems • Automatic Fuel Flow Control Systems • Supercharger Airflowing Systems

This is the growth of the



**It is likewise an excellent forecast
of the promise this great undeveloped medium
of transportation offers to American Industry**

THAT little circle at the left above represents the value of products manufactured by the aviation industry in 1939—\$250,000,000.

In 1943 that value will have increased 36 times over to the staggering figure of \$9,000,000,000.

The sheer statistics of aviation's growth tax the imagination. An industry employing a relative handful of men in 1939, aviation will next year keep a million and a half workers busy. Even in its high-production years our giant peacetime automotive industry employed but one-third that many.

But the war has done more than bring us this huge market of today.

We've shown us that we've just scratched the

surface possibilities of the airplane's utility. Yet, we've used it to carry perishable and rush products by air express. Air mail and air travel have grown steadily, though many still regard them as luxuries. But the big payload—freight—will soon be by truck and by boat at the beginning of the war.

Now we are beginning to see the clear outlines of air transport taking shape in its ultimate form. Huge airlines will be able to carry first-class mail at no increase in rates and air cargo-carriers will handle freight-car loads at freight-car rates, time considered.

The possibilities of air transport are limited only by our imagination and resourcefulness in using this remarkably flexible method of transportation.

Aviation Industry in 5 short years . . .

Obviously the time to establish your position in this coming field of commercial opportunity is now.

The method of sales communication has long since been well established.

26 years ago a magazine called *Aviation and Aeronautical Engineering* hung out its publishing shingle. It traveled with the industry through its long years of pioneering and experimentation, its successes and its failures.

For the men who guided and built the aeronautical industry *Aviation* has been since 1916 the effective vehicle of communication.

Today the serious-minded men of the industry depend on the authoritative editorial pages of *Aviation* to bring them the up-to-the-minute information on production, design and engineering advancements, the significant developments in military and civil aviation.

both here and abroad, the news of the industry in proper perspective.

The men who are building our air power today and who will build our air commerce tomorrow, look to *Aviation* as a fact-on-the-ground aeronautical industry publication—news resource or glance.

Aviation is edited for and read by the influential men of the industry, the men who can say yes-or-no, the only group you are interested in reaching through your advertising.

Here are just two of many examples of *Aviation's* editorial influence among the men who are the buying power of the industry . . .

Example 1—When *Aviation's* editors recently uncovered the story of a revolutionary new method of forming metal sheets on large rolls, a flood of mail poured in from busy engineers and production men . . . "Tell us more!"

Example 2—A second letter-carrying to top aeronautical manufacturing executives disclosed that better than 3 of every 4 not only read *Aviation* regularly but find it useful in their daily work. The letter went only to the highest ranking men in 110 aircraft, engine and propeller plants—presidents, chief engineers, general managers, production managers, purchasing agents, etc., so you know the rank of decision-making heads.

AVIATION'S LATEST MARKET FACTS . . . just off the press

This 12-page booklet, an indispensable life of American Aviation, and Marine Information is now available to you. Designed for salesmen, it's a complete picture of the market today, a glimpse into the market tomorrow. Complete editorial coverage and advertising information on AVIATION. A request on your business card will bring your copy promptly, without cost or obligation.

Aviation aims its editorial content, its circulation effort at the buying power of the industry—not the masses of workers and flying fans.

That is why *Aviation* today leads all other aeronautical publications in advertising gains.

AVIATION

A McGraw-Hill Publication • 310 West 42nd Street, New York, N.Y.



OFFICES IN CLEVELAND, DETROIT, CHICAGO, BOSTON, PHILADELPHIA, WASHINGTON, ST. LOUIS, ATLANTA, SAN ANGELES, AND SAN FRANCISCO

AVIATION November 1942





What's all this talk about Altitude?

Aircraft have missions to perform at various altitudes.

All military aircraft are designed to give their best performance at some specific altitude.

If it's way up you are talking about, up as high as a fighting plane of any nation has ever sought or met an enemy, that's as much more as any other level to an Allison engine.

For the Allison engine, combat

with the turbo-supercharger, is the power that makes the Lockheed "Lightning" (shown above) the world leader at the highest altitudes at which planes fight.

And when comparing American fighting planes with foreign competition, don't forget that the American ships carry more weight because of their superior protective armor, heavier fire power, longer range and better maintenance.

Allison
DIVISION OF



BORING HOLES in turbine case of turbine engine demands high speed, grinding wheels that have very deep flutes & thicker "V" design to continuously, it drills a hole. While waiting for special machine tools, the operator of this plant reports that B & D drills saved 2 to 4 weeks in waiting period and were so satisfactory that they are being used permanently.

These Tools get 'em in the Air . . and keep 'em There

INDOCT ACCIDENT is grinding turbine case.

Black & Decker Tools... the tools that make the difference between a job well done and a job not done.



STEEL WALL AND PRESSURE are constant in turbine case when, heat, sparks coming in contact—metal drilled with heavy duty Black & Decker Drills. In all kinds of maintenance work, grinding—Black & Decker Tools are being used the world of American military air fleet.



FROM the planes that build America's daring fighter craft to the assembly lines of giant cargo ships . . . on engine mounts of trainer planes and wing frames of dive bombers . . . in service and maintenance shops the Allied-world over . . . more Black & Decker Portable Electric Tools are in use—drilling, driving screws, sawing, grinding, welding, metal cutting—than any other in wartime industry.

Because Black & Decker Tools answer the aircraft industry's first law—do the job faster—they are first choice when the going's tough and schedules "impossible." They get first call from the men who want a power tool that "tools right," is bulky enough to "take it" at any speed "round the clock. And whether they are called upon to work on metal, wood or a dozen different plastics, it's all the same to B & D Tools . . . they "produce" with high speed precision regardless of the job.

HELP . . . in a HURRY! If you have a production problem demanding you get the work with your nearby Black & Decker Distributor. He's dependable, convenient, as a source of supply or a "hot information" expert. The Black & Decker Mfg. Co., 128 Pennsylvania Ave., Troy, Mich.

Get in the Scrap with Your Scrap!



MAKING HOMEOWNERS EVERYWHERE

Black & Decker

PORTABLE ELECTRIC TOOLS

PROPELLERS over the ATLANTIC



Streaming through the skies above the Atlantic, the U. S. Army's Air Transport Command is piling up a brilliant record in delivering hundreds of Boeing, Consolidated, and Lockheed bombers to Britain.

In millions of miles of trans ocean operations no pilot has ever had to worry about his propellers. All of these bombers have been equipped with dependable Hamilton Standard Hydromatic propellers.

HAMILTON STANDARD PROPELLERS

One of the three designs of

UNITED AIRCRAFT CORPORATION, EAST HARTFORD, CONN.



NEWS

ALAN DUBOIS/AVIATION

C. H. MACAIGR/AVIATION

F. J. HIGGINS/AVIATION

J. H. PETER/AVIATION

War Labor Board to Establish Pacific Wage Stabilization Committee

A Pacific Coast Aircraft Manufacturers Committee will be set up by the War Labor Board, as a result of data presented at a hearing held in Los Angeles Oct. 12 to 17. The committee is to be organized by Chairman Paul B. Porter. WFLB chairman expert who organized the hearing for the WFLB, will be composed of representatives of labor, management, Army and Navy officers, and a WFLB chairman. It will have full authority to make award changes, within the limitations imposed by Executive Order 9405 and WFLB policies. Evidence supporting operations of widely varying labor supply rates, and other factors, was reviewed and submitted the inapplicability of attempting to set uniform rates over the large regions of the nation. Higher award rates in the Los Angeles area, and in the San Francisco area, were cited by the Boeing Aircraft Co. in its representation for the area. A \$400 to \$500 wage rate in the Los Angeles area, and a \$300 to \$400 wage rate in the San Francisco area, were cited by the Boeing Aircraft Co. in its representation for the area. A \$400 to \$500 wage rate in the Los Angeles area, and a \$300 to \$400 wage rate in the San Francisco area, were cited by the Boeing Aircraft Co. in its representation for the area.

Boeing's California night plant recommended a starting rate of \$400 and work out to top three labor organizations at the AFL, CIO, and the Independent National Union of United Aircraft Workers. The latter had been willing to give and that the most complete list provided by the WFLB. He will provide for protection to the WFLB and will also make recommendations on whether or not war workers should be included or excluded. The WFLB is expected to render its verdict within two months and it will provide that labor will keep its demands within, even if it does not go beyond the recommendations made by management. The War Labor Board, which Chairman Porter will preside, is expected to be organized in the near future. It will be composed of representatives of labor, management, and the military. It will be the first of its kind in the history of the United States.

The first time in the history of the War Labor Board, management will be represented by a joint committee to represent the labor union. The committee will be composed of representatives of the labor union, management, and the military. It will be the first of its kind in the history of the United States. The committee will be composed of representatives of the labor union, management, and the military. It will be the first of its kind in the history of the United States.

Boeing representatives indicated that higher wages paid workers in other portions of the industry are making heavy restrictions of labor from the Pacific Coast plant. They indicated that it is in the Los Angeles area, and in the San Francisco area, were cited by the Boeing Aircraft Co. in its representation for the area. A \$400 to \$500 wage rate in the Los Angeles area, and a \$300 to \$400 wage rate in the San Francisco area, were cited by the Boeing Aircraft Co. in its representation for the area.

other war industries. One of the main objectives of the committee will be to stabilize production of war materials and to ensure that the war effort is not hampered by labor disputes. The committee will be composed of representatives of the labor union, management, and the military. It will be the first of its kind in the history of the United States.

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Set Tube Standards
About \$20,000,000 of steel tubing will be needed for military and gas turbine engine work. Federal government has decided to set standards for this tubing.



PRESIDENT VISITS AIRCRAFT FACTORY
President Roosevelt during his visit to the factory, visited a Douglas Aircraft Company plant where he saw both bombers and cargo planes out of the assembly line. He is shown here in a second discussion with General Robert L. Egan, president of Douglas, and Frederick W. Gertel, Douglas representative in charge of manufacturing.

streamed from, and 1945 to complete the air war program. The Airline Manufacturers Association, the National Aircraft Standards Committee, is cooperating with the Army. May and WFLB is developing a list of standard labor rates which will help control manufacturing costs. The office of the national chairman of the NARC is maintained in Washington by the Army. Chairman of the NARC is General H. H. Arnold.

A. S. and Britain in Standards Program

Standards program is being made more comprehensive of standards by United States armed forces and by the British as American-made aircraft are shipped to Britain. The British are now using their own standards but are not sure of their own standards. The British are now using their own standards but are not sure of their own standards. The British are now using their own standards but are not sure of their own standards.



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Albert C. East, Elliott Beckwith, Charles F. Moore, Edwin C. Ramsey, Arthur C. Davis, Frank D. Wagner, & E. Thompson

NAVAL FLYING OFFICERS PROMOTES TO RANK OF REAR ADMIRAL

Increased participation in the Navy High Command has been given evidence by promotion from Captain to Rear Admiral of seven flying officers. In making the nominations, the Navy Department said the men in this group were flying carriers who had actually flown them, some with four years or more. History has told us that Albert C. East, former Navy pilot

who was in command of the NC-4, first plane to cross the Atlantic in August 1911. Also on the list is Elliott Beckwith, who was in command of the carrier Winthrop through the Battle of Midway. Charles F. Moore, a pilot who has been over 20 years experience, was also awarded

(Continued on page 10)

CALLING NAMES

Naval flying officers have been promoted to rear admiral rank by the Navy Department.

Albert C. East, former Navy pilot who was in command of the NC-4, first plane to cross the Atlantic in August 1911. Also on the list is Elliott Beckwith, who was in command of the carrier Winthrop through the Battle of Midway. Charles F. Moore, a pilot who has been over 20 years experience, was also awarded

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E. Thompson, who was in command of the carrier Winthrop through the Battle of Midway. Charles F. Moore, a pilot who has been over 20 years experience, was also awarded

Albert C. East, former Navy pilot who was in command of the NC-4, first plane to cross the Atlantic in August 1911. Also on the list is Elliott Beckwith, who was in command of the carrier Winthrop through the Battle of Midway. Charles F. Moore, a pilot who has been over 20 years experience, was also awarded

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NO INTERNAL DISSENSION HERE

Clutch and Valve "Harmony" Is Machined from OHIO SEAMLESS TUBING

Even in quiet flight formation every part of the operating mechanism must do its intended duty smoothly and continuously. At some of the most vital spots in many types of fighting aircraft, this wear and tear responsibility is shouldered by a partnership between OSTUCCO tubing and accurate machining and finishing.

Two such vital parts are valve rocker shaft bushings and high ratio clutch gear bearings. Beyond meeting strict Army and Navy specifications, special care is taken in drawing and treating the tubing to provide properties which help in later operations. For this reason Ohio Seamless Tubing has earned a reputation as a consistently consistent source of low rejection percentages over a long period of years.

New steel, new specifications, a wide variety of gauge lengths and finishes provide a wealth of new experience that is invaluable in solving the problems of present and prospective customers.

Ohio Seamless Tubing is a leading source of low rejection percentages over a long period of years. New steel, new specifications, a wide variety of gauge lengths and finishes provide a wealth of new experience that is invaluable in solving the problems of present and prospective customers.

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THE OHIO SEAMLESS TUBE COMPANY



WORK IT HARD, BUT GUARD IT WELL



OF COURSE, you are driving your Aluminum Alloy equipment to the limit. We need every gallon, every pound, every foot, every piece of the products that can possibly be produced to help win the war. But, bear in mind that you must make your equipment last a long time.

YOU CAN lengthen the life of hard-working, irreplaceable Aluminant Alloy equipment. Here are some ways of doing it; each must be engineered to suit the problem.



CATHODIC PROTECTION has proved effective where the chemicals or cooling water employed are corrosive. Simply add zinc strips in the right places, and the corrosive attack is stopped or slowed down considerably. Alcoa engineers, with years of research on such problems, can advise you on how and where to place these strips.



PROTECTIVE COATINGS offer another means of making Aladurum. Alloy parts last longer. Corrosion resisting, pure Aluminum coatings can be applied by spraying. Oxide finishes are produced by chemical and electrolytic treatment. Baked resin coatings are very effective, where Aladurum is subjected to severe attack.



RETAILIZING—budding up worn, corroded, or damaged Aluminum parts with new metal—will give these parts a new lease on life.

INHIBITORS may be the key to longer life of Aluminum Alloy processing equipment. Only a few parts of inhibitor per million of liquid are needed to deprive corrosive materials of their kick. Here again, the research of Alcoa engineers will guide you.

ALCOA ENGINEERS stand ready to help you get every possible hour of service out of your Aluminum Alloy equipment. Write and tell us your problem—Aluminum Company of America, 1182 Gulf Building, Pittsburgh, Pennsylvania.



ALCOA ALUMINUM

Eight Eastern Aircraft Manufacturers Establish War Production Council

To speed work plans, Princeton, N.J., based GARDINER-DAVEY INC. formed a non-profit corporation known as AIRCRAFT WORK PROBLEMS CAUSEWAY. The new group is designed to reduce a successful Pacific Coast organization the coastal place to pool resources in solving manufacturing technique difficulties. The group is headed by ROBERT J. GARDINER, president of the company, with the

At present the council consists of eight air frame manufacturers whose policy will be governed by a board of directors.

was made up of the heads of the member companies. The group included Guy Vlasak, president of the firm and chairman of the council; William L. Martin, first vice president of the council and president of Citrus L. Martin Co.; Victor Kinnaman, Aradine Corporation; L. D. McNeil, McNeil Aircraft Corporation; C. A. Van Doren, Research Aeronautical Corporation; and C. Gordon Brown, Hamilton, Hartung & General.

Ryan Builds Combat Places For Navy

[illegible]

The Genie type is a Wright Corp design. As being a

Krya, the SC-14 is a mid-range monoplane powered with a Rotax-mounted V type in-line 12-cylinder air-cooled engine, an all-metal construction of semi-monocoque design with a two-piece fuselage concept arrangement. Wings and tail suit one of two power plans.

Metal Roofing
Plan Formed

Waxes like your drawing board as much as the drafting table. He is a draftsman at heart, and he has a good eye for detail. He is a good listener, and he is a good communicator. He is a good leader, and he is a good team player. He is a good person, and he is a good friend.

peaks contracts will be sold in whole or a certain amount of certain products. These certain contracts will be based on the amounts of yields and other materials in WFO's inventory, which is now approximately 100,000.

Later Allocation Predicted More Women for Factories

Wright, at Ottawa, Ontario, and Ferdinand Stenwald, of the Army-Navy Museum, Washington, D. C., said:

Wagon is a part of Nelson's plan to coordinate the flow of materials with production schedules. Wilson will use that production schedule as input and identify what requires additional resources, such as

NACA Shifts to Projects Of Immediate Importance

The National Advisory Committee for Aeronautics has changed its program to cover more projects of im-

jects. This policy applied
all of its major docu-

Some of the immediate problems in the SAGAs, chemists here must be aware before production of several new engines and other aircraft parts starts. This change is necessitated by rapid obsolescence of items in the waste areas of war aviation.

SAGAs officials do not possess any of the secrets, but reasonable adaptation is that

the year 2001 there will be some kind of steady improvement for the Executive to tell workers to take certain jobs as it is stated in the plan. It is a delicate undertaking in a democratic society just how far the law may go and how far the President might go in the future. The law is not to be told in advance. Right now the personnel would be



INVADING MEN'S FIELD
Womans talks over drabbing limits for staying work on details of Rafe Reyes abroad, saying limits built by PFCAN. The info seems to come from and advances progress rapidly to status of other drabbing. Puckett leaves this is the first time women have been awarded by order of the staff, the drabbing

THE BOYS IN OUR PLANT SUGGEST A NEW USE FOR AN

ACTUS HOSE CLAMP



ACTUS HOSE CLAMPS help to "ring up" New Production Reasons for 8 GOOD REASONS

1. Completely reliable
2. As is checked by manufacturing plant
3. As is checked by military inspection
4. As is checked by the Army
5. As is checked by the Navy
6. As is checked by the Air Force
7. As is checked by the Coast Guard
8. As is checked by the Marine Corps

ACTUS PRODUCTS CORP.
MOUNT VERNON,
NEW YORK

ad the effect of selective service in armed forces, the need for a large-scale training program for new employees, the improvement of new equipment, and, lastly, the need for the most efficient utilization of available manpower. The committee approved the increased employment of women in the office and ground duties at the Air Force and favored the creation of a labor-management committee to facilitate the cooperation of civilians and management need in the Air Force.

Army Takes Over Work Of Pan American Air Ferry

ARMY crews took over the operations of Pan American Air Ferry on Oct. 1 when the command expanded the War Department announced. Ferry-

ing from Seattle and other aircraft to America and Allied bases in the Middle East was handled directly by the Air Transport Command under Maj. Gen. Henry L. Henshaw.

The official statement said that Air Force considered it undesirable to have civilians operate the military planes, and that some of the planes were on the service will be concentrated and will continue to be operated by the Army, in making the change, simply wants to not separate by the difference between civilian and military pilots.

It is understood that both military and civil airplanes are being sent to other bases in addition to PAA facilities. Under PAA and Air Force, the Army would make no comment regarding the status of these aircraft.

10 Cargo Types Fly War Routes; Alaska-Russia-China Run Opened

Washington (AP)—The Air Force today announced that it has received 10 types of cargo planes from the Air Force, and that it is now operating them in the Pacific. The planes are being used to transport cargo from the United States to the Pacific, and to transport cargo from the Pacific to the United States.

The Air Force today announced that it has received 10 types of cargo planes from the Air Force, and that it is now operating them in the Pacific. The planes are being used to transport cargo from the United States to the Pacific, and to transport cargo from the Pacific to the United States.

Although the experts are agreed that 10,000 planes of the B-29 type could carry the load of the Pacific, the Air Force is now operating them in the Pacific. The planes are being used to transport cargo from the United States to the Pacific, and to transport cargo from the Pacific to the United States.

If the war continued, the Air Force would need a large number of cargo planes. The Air Force is now operating them in the Pacific. The planes are being used to transport cargo from the United States to the Pacific, and to transport cargo from the Pacific to the United States.

From Coast to Britain, via Iceland, and the South Atlantic to Africa and Egypt, and to the South Pacific, the Air Force is now operating them in the Pacific. The planes are being used to transport cargo from the United States to the Pacific, and to transport cargo from the Pacific to the United States.



GOOD NEIGHBOR ROUTE

The new route nearly opened to Alaska City by Russian Airlines, the planes were sent to the United States to the Pacific, and to transport cargo from the Pacific to the United States.

—where the spirit is "WE"

YOU SENSE IT the moment you enter an Interstate plant... a spirit easy to recognize yet hard to define. A spirit of teamwork, of shoulder-to-shoulder service in a great cause.

Here a complete complement of the finest precision machines operate 24 hours a day, 7 days a week. Here master craftsmen turn out vast quantities of vital aircraft units as finely measured as a Swiss watch. Here a large corps of trained inspectors with minute gauges and costly testing machines check every operation, every part, that go into these fighting units.

All play the game together. All have the same passion for precision, the same blending of accuracy and speed. All are moved by the same quick-step spirit, a spirit that makes every Interstate operation spell co-operation; a spirit of "WE."

Interstate

AIRCRAFT AND ENGINEERING CORPORATION • 81 SEGUNDO, CALIFORNIA



South Wind Heating MEETS YOUR NEEDS

Both combustion and exhaust-gas systems—developed and proved under flight conditions—permit unbiased study of your problems

WIDELY varying installations demand widely varying equipment. And unbiased recommendations for your needs can best be made by someone who knows and supplies all types of equipment.

Stewart-Warner can recommend without prejudice. Because Stewart-Warner has a full line—not just a few—to push. South Wind hermetic combustion heating is many specially engineered facets, is serving on every battlefield—the most widely accepted aircraft heating equipment in the world.

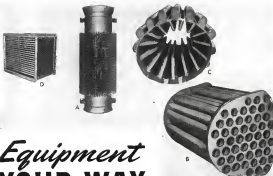
In addition, Stewart-Warner has developed four different types of exhaust-gas heat exchangers. These new heat exchangers are the result of new special kinds of skill. First, Stewart-Warner knows combustion-gas heating from years of experience in making the best exchangers which are a part of every South Wind combustion heater. Second, Stewart-Warner knows aircraft requirements and practices, from

years of close cooperation with aircraft engineers.

Custom development and design is based not only on advanced theory but on practical world-wide experience. Engineering facilities extend of its ordinary heating practices are employed constantly. . . . Facilities for producing exhaust gases ranging up to 3 million lbs./hr. per unit. . . . For simulating flight conditions above the ceiling of any known plane. . . . For delivering heating equipment as you wish performance known in advance. . . . And, fully developed data on each type is available on request.

Thus, with by far the most extensive experience and most comprehensive line of combustion-gas airplane heating equipment in the field, Stewart-Warner can recommend impartially the best sources best suited to your needs. And the engineers there in advance to the operating and installation conditions to be encountered.

For an individual appraisal of your problems, write in detail.



Stewart-Warner develops four basic types of exhaust gas heat exchangers in which complete performance data is now available. The finned-tube (A), Tube-Bundle (B), and Hollow-Fin (C) types are phased for passage of all exhaust gas and exchange of only the required amount of heat. The Devers-type (D) directs only a fraction of the gas and extracts substantially all the heat. Each type has its place in the solution of heating problems.



Now available in each of above exchangers is full data and curves showing: Heat output vs. exhaust gas rate; Heat output vs. venting air rate; Pressure drop vs. exhaust gas rate; Pressure drop vs. venting air rate; Exhaust temperatures at all critical points under all conditions of operation.

Extensive developments in South Wind hermetic combustion heating equipment are constantly making new demands for compact sources capable of delivering tremendous heat where, when and in amount: In a wide range of aircraft operations, and with economy equipment to fit various special requirements, they meet problems involved by any other means.

South Wind HERMETIC COMBUSTION Heaters

HEATER DIVISION, STEWART-WARNER CORP., CHICAGO

West Coast Office: Stewart-Warner Aircraft Heater Engineering and Service, 1271 Wilmet Road, West Los Angeles, California

AVIATION November 1942

AVIATION, November, 1942

297

**THE RADIO "LAB"
THAT GOES ALOFT**

On a special mission, radio communication between plane and base may be limited to specified frequencies . . . during specified minutes. That, for the radio

With the "BENDIX" Frequency Indicator he accomplishes this with laboratory precision . . . adjusts his set, begins transmitting . . . is a matter of seconds.

Men and women of Bendix Radio take pride in knowing that receiving and transmitting equipment bearing the "BENDIX RADIO" nameplate is flying with our fighting pilots on all our vital battle fronts.

Products of the Bendix Traffic Division are important mainstay of "The Ironside Corp." . . . precision built and rugged control systems which 25 Bendix plants from coast to coast are speeding to and fighting every air world traffic battle.





THE LOUIS ALLIS CO., MILWAUKEE, WIS.

AVIATION PEOPLE



RUSSELL WEAVER, JR., former Allen (center) and John W. Overberg of Damco, American.



JOHN W. OVERBERG of Damco, American, formerly of Air Force "and most recently of "Vitalis," the assistant of the Bureau of Aeronautics and the Army Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



JOHN W. OVERBERG of Damco, American, formerly of Air Force "and most recently of "Vitalis," the assistant of the Bureau of Aeronautics and the Army Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



W. R. SHERRILL who was previously manager, and now works as a consultant, and subsequently, as a consultant of the Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



AMOS GILBERT has been appointed as vice president and general manager of the Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



ELVAINE HAYNES who has been with TWA is the executive representative for the past year has been named head of the new airline department, a position formerly occupied by her. During many other positions she was traffic manager for the United Air Lines organization.



DONALD EVERETT, president of Everett Corporation, has been named chairman of the executive committee of the Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



CLAYTON C. SHAFFER, general manager of the Air Force, has been named chairman of the executive committee of the Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



JESS SORENSON who has been named chairman of the executive committee of the Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



GERALD "DICK" CLE, executive manager of the Air Force, has been named chairman of the executive committee of the Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



HARRY L. BRASHERS has been named chairman of the executive committee of the Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



WILLIAM T. HEILMAN, who has been named chairman of the executive committee of the Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



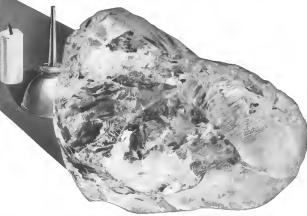
B. D. WALLACE has been named chairman of the executive committee of the Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



HAROLD R. HARGIS, vice president of the Air Force, has been named chairman of the executive committee of the Air Force. He has been in aviation since 1934 and is the newly appointed assistant manager. He has been in aviation since 1934 and is the newly appointed assistant manager.



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This permanent tracing paper is transparentized with Albanite

No oil, no wax—just a remarkable new transparentizing agent developed in the K&E laboratories—produces this truly permanent tracing paper! ALBANITE is made of 100% long fiber pure white rags—treated with Albanite—a new crystal clear synthetic solid, physically and chemically inert. ALBANITE will not oxidize, become brittle or lose transparency with age.

Equally important, ALBANITE has a free hard "touch" that takes ink or pencil beautifully and erases with ease... a high degree of transparency that makes tracing simple and produces strong sharp blueprints...

extra strength to stand up under constant correction, filing and rough handling. ALBANITE has all the working qualities you've always wanted—and it will retain all their characteristics indefinitely.

Make ALBANITE "your own" on your own drawing board. Ask your K&E dealer or write us for an illustrated brochure and generous working sample.

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GENERAL OIL Most permanent tracing paper is made of oil-treated paper. It is not permanent. It is not resistant to heat, light, and air. It is not resistant to water.

VEGETABLE OIL Most permanent tracing paper is made of vegetable oil-treated paper. It is not permanent. It is not resistant to heat, light, and air. It is not resistant to water.

ALBANITE has unique properties. It is made of 100% long fiber pure white rags—treated with Albanite—a new crystal clear synthetic solid, physically and chemically inert. ALBANITE will not oxidize, become brittle or lose transparency with age.

K&E Albanene
THE STABILIZED TRACING PAPER

Recent Books

HANDBOOK OF WAR PRODUCTION, by Edwin Arthur Repp. Published by McGraw-Hill Book Company, New York. 347 pages. cloth, approximately \$1.00.

From interviews with more than 200 government officials and manufacturers already engaged in war production, Prof. Repp of the Massachusetts Institute of Technology has produced a hard, necessarily practical study on exactly how government manufacturers can get into the war business.

For managers of large and small plants he has analyzed the specific steps required in government of materials, measures to raise production, procurement of materials and supplies, production planning and control, labor and expenses, quality control of war production, conservation of materials, materials, industrial accounting as warlike, planning for war materials, and planning and control in manufacturing.

Warnings on pitfalls and specific suggestions on solving these problems are illustrated with frequent references to experience of companies are producer weapons. Prof. Repp recommends the director responsible for their success in all manufacturing, accurate accounting and approval of plant facilities, close contact with government and manufacturers, make quality control, and constant, careful checks on scheduling and progress of operations through Gantt Progress and other charts.

"Knew where you are going, and more here and needs to get there," advises war manufacturer. This book is a detailed, useful elaboration of the general instruction.

THEORY OF FLIGHT AND AIRCRAFT DESIGN, by Bert A. Biot. Published by McGraw-Hill Book Company, New York. 20 pages. approximate distribution, and index \$2.15.

METEOROLOGY AND AIR NAVIGATION, by the same author and publisher. 180 pages. approximate distribution and index \$2.25.

These revised, approximate volumes, issued under the general title *The Pilot Training*, are designed, says the author, to give student pilots "all the information necessary to pass the written examinations for a private and commercial pilot license."

Theory of Flight and Aircraft Design are two sections of one book. The first reviews the laws and types of planes in flight and the second describes the details of the engine which keep them there.

Meteorology and Air Navigation

AVIATION, November, 1942

pages is divided into two parts. From the study of weather (the atmosphere, air currents and storms, and fronts and related air movements) the author proposes to the practical use of maps and charts, the compass, radio navigation, drift problems, air-navigation compasses and graphs, and finally give a study of aerial navigation.

Both books are simple written, personally devoid of technical terms, and make serious, common-sense, helpful in breaking up for government examinations.

AIRCRAFT WRITING FUNDAMENTALS, by George E. Tolson. Published by the Evans Publishing Company, Milwaukee. 21 pages. illustrated, paper bound \$0.50.

Elemental facts for student writers presented in simple illustrated, letter writing lesson charts in emergency step-by-step shop instruction. For beginners only.

TENTATIVE STANDARDS AND RECOMMENDED PRACTICES AND PROCEDURES FOR SPOT WELDING OF ALUMINUM ALLOYS, published as an emergency standard by the American Welding Society (New York) with the approval of the National Aircraft Standards Committee. 48 pages. illustrated, paper bound \$1.

Concerning an over-diagram subject, this tentative standard presents information on the use of "welding equipment" with the latest available data, design, and developments in surface preparation, standards of welding quality, technique, testing, and inspection of resistance welds.

It was prepared by a committee of welding engineers (most of them in aircraft construction) who report, as manufacturers to keep them posted on further developments which should be incorporated in future versions of this paper.

PRIMER OF AIR ENGINE TAKES THE HOT ROAD, by Alex. Repp. Published by the McGraw-Hill Book Company, New York. 243 pages, approximate index distribution \$2.50.

Popular, personal examinations of a government-provided air inspection of flight in the manner of 1941.

Most valuable, however, is a 18-page appendix filled with data and figures on flight's promotion of aviation, pilot training, and, more important, and military flying, and aircraft production. Mrs. Thayer has also accepted distribution.



15 cents

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NEW YORK

PUT THE HEAT ON HEAT TREATING

...more speed...fewer rejects
...lower costs!

"Turns 40% Reject Loss Into 100% Output Of Vital War Parts"

Is the heat treatment of small parts an important step in your production of finished war products... then read this!

One large manufacturer's total output was constantly being slowed down because of rejects that ran as high as 40% during heat treating. The remedy? Let Garrett do them! Today, hundreds of thousands of these parts are being heat treated by Garrett... held to the most exacting specifications... and there hasn't been a reject yet.

Let Garrett Heat Treat For You!

Whatever kind of small parts you are manufacturing—up to 2" x 2"—Garrett offers you the possibilities of more speed... to reject... and resultant lower costs. Our plant is fully equipped with the latest type of equipment to efficiently heat treat bullet cores, gun sight parts, fuse parts, etc. in small or large quantities—as much as 10,000 pieces daily. Exacting scientific heat control instruments guarantee you hardening and tempering that is held to a tolerance of within 2 points of Rockwell Hardness. Controlled heat treating which makes possible "Guaranteed Treatment." That's why we have heat treated millions of parts without a single reject.

Before you place your next order for heat treating small parts—up to 2" x 2"—write, wire or phone Garrett! You'll be so proud of the quick service and high efficiency available You'll be pleased with the reasonable price.

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Mfrs. Diamond G Lockwasher and Flat Washers

information on various steps in his 12,000 ms. answer, and his interesting companion, female photographer Julia Maria, has provided plenty of pictures.

TRUE STEEL by Clancy Bush. Published by the John World Company Indianapolis. 219 pages. paper. illustration \$1.00.

A consequently written biography of George M. Verrill, who was of tonight in industrial research and sympathy and understanding for his employees who saved the American Building Mail Company to a prominent place in the steel industry.

THE FLYING TIGER by Basil Winton. Published by the Flying Press New York. 224 pages. non-illustrated. \$1.00.

A day-by-day, occasionally colored account of Lord 40 year old Claire L. Chivers of Waterproof, La., retired from the Army Air Corps for medical reasons, and his American Volunteer Group, including the famous Road brought down an official 250 day paper and perhaps 300 more pictures in little more than six months.

Against 1,500 enemy machines, the AVG, which never had more than 35 flyable, outdated P-40s, lost 8 killed and 6 missing in action, 22 in bombings and accidents. He effectively did only 74 pilots here that the day before he had 400 men. "Our losses were heavy," he says. "Our losses were heavy," he says. "Our losses were heavy," he says.

"It was the first time I've ever seen," he says. "It was the first time I've ever seen," he says. "It was the first time I've ever seen," he says.

THE STORY OF THE AIRSHIP (NON-FICTION) by Hugh Allen. 19 pages. Illustrated, colored. \$1.00. The Story of the Airship. The Story of the Airship. The Story of the Airship.

A striking history of the airship to prove them the most efficient weapons in the history of aerial warfare. Many a story can now be told "right up to the minute," says the author of this volume. A special presentation of the airship, which will make reading special power, showing a special (and now progressed) story.

ENGINEERING INDEX WITH ILLUSTRATIONS by Engineering Index Inc. 20 W. 2nd St., New York, N. Y. \$1.00.

Contains 30,000 illustrations of important articles published in current technical periodical literature during the year and 40,000 cross references to these articles.

Also included is an author and contributor index as well as a list of the publications reviewed.

THE FIRST MOLDED PLYWOOD BOMBER-TRAINER



Another Fairchild Achievement

with HASKELITE *Plymold**

The design of the Fairchild AT-13 is the result of brilliant engineering and advanced research in molded plywood. As a result of this work (that is on now after Plymold) having these advantages:

Where good bonded plywood can now be molded to compound curvatures. Stress for complete fastenings as well as wings, tail assemblies, nacelles, fairings, etc. can now be molded over simple dies on a production basis.

To eliminate the weight of stress materials, yet meet stress requirements, thickness variations can be molded into any panel. Reinforcing members can also be incorporated as an integral part of the molded structure.

New facilities now being completed provide equipment for the manufacture of the world's largest molded plywood sections on a production basis.

Right now you can use Haskelite, but the possibilities of this structural material for post-war use appear almost boundless.

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*Plymold also produces waste cores and discarded or broken articles. Discarded articles.

HASKELITE

MARINE PLYWOOD AIRCRAFT PLYWOOD PLYMOLD*

Plymold

Phemaloid

FLEETWINGS

Builds the parts for
America's Air-mada



IN a hundred plants scattered over the country, America assembles the air-mada to man the air over every fighting front.

But before the planes (and Victory) must come the parts—wings, fins, tail surfaces, adorns, stabilizers, fuselage sections, and more.

Fleetwings is building these parts... by the hundreds, by the

thousands. And Fleetwings is building them faster than they have ever been built before.

To do this, Fleetwings pioneered with new aerials, new techniques, new processes. Old methods of fabrication were streamlined, new methods invented.

Although our present production is all for Victory, we haven't

forgotten the future. Plans for that future are on Fleetwings drawing boards now. With Victory they will be revealed and the pioneering of Fleetwings engineers will add still greater chapters to America's air history.

FLEETWINGS
Incorporated
BRISTOL • PENNSYLVANIA

AVIATION, November 1942

FLEETWINGS

pioneers with parts
and hydraulic
equipment



The RT-11, an excellent engine mount built for the B-24, keeps the engine

TO "KEEP 'EM FLYING"—In addition to building several new and old parts for other manufacturers, Fleetwings also builds complete planes. The Fleetwings-designed RT-11 has more than passed the needs of standard test for military aircraft. It's the first all-metal, single-engine, single-engine aircraft constructed principally of stainless steel.

LAST OF IT TO FLEETWINGS—To give a "test" to the nation's top engineering program, the Fleetwings plant, there's no active company to drop away from the company's wing. Most plane hardware—wings, fins, motor, shock, and other parts—being made of through a company-wide program which stresses that "every steel is a better" and that plane hardware should be tested as though it were exposed to the most severe test it is left where dropped.

OVER 1,000 WORKERS—were saved as a result of jobs at Fleetwings through the use of a new and simplified technique for producing parts. Another example of how Fleetwings is speeding up and plane parts production.

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America at War

(Continued from page 35)

The hardest of all engineers' jobs is to build adequate fighter planes. The fighter plane needs something every one of its functions, and yet it must approach the impossible in every one of them (See Factory Controlling Aircraft Design and Control, page 69). So the designers, using the high-speed B-17 group, at once and keeping the fighters down to the last, are working it, just before they might see it, they build it, the airplane fighter and constructor, at one destination. That's not a problem, it's only an idea before in a few days.

A fighter has more parts than a heavy bomber, and it's a ruggedly stressed in the night space, still, it's fast and agile, and can fly very high. It carries out of the ground its own defense. But think what the aircraft is up against. A last known ton of B-17's would have a hundred or more parts, with an axial lot of these able to play its own character. The fighters are flying in getting hit just about as they would by drops of water in a rain storm.

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High Level Bombing Begins

This is not meant to sound optimistic. The Germans have a lot about high level bombing by now, and they will try to catch up with our lead as fast as they can. It will be hard for them, because

in that particular line, we are two years in front. Immediately, when Germany submitted this country, only two or three lines were approved of the idea, and one of them was Gen. Frank Andrews, formerly chief of the Air Corps, and now in command of the Combined forces. The British navy that doing "inside a during" happened" and on that point you may want to agree with them.

The performance of the B-17 is a good example of the performance of the new planes in general. There have been a lot of words on that subject lately, for better or worse. Some people think the machine, sometimes in a word, sometimes in a word, was never a good way either for the fully-did-

Others think all the talk necessarily demoralized the people, who are getting more willing now for airplanes than the total of the national debt just before the war. Suddenly it dropped the flying space of some of our pilots, who thought they were getting hit down by the loss of their planes.

Anyway, Congress took an interest in all the noise, and the House Military Affairs Committee called in plenty of aircraft and military men who have

what's going on and why, and got the whole story. The construction board all about the machine that have gone under the hood, and shipped them. Much detail of interest is included in the report but in the end the committee came to an especially interesting conclusion—probably the most one that has been stated more times by officers and others responsible for the better power of our airplanes.

The committee said: "In the final analysis, it is the best sense that counts. It is to be compared the speed, performance and maneuverability of one plane against another when engaged in war. There is a great deal of sense in this. It is only common sense to say that one plane and one pilot are performing completely well when they are knowing down two or three enemy planes to every one of our own that is lost."

It is too bad that all the work of our various planes cannot be reported as this space, but they have to take their cases as they pay the price. One other, which may show up in better cases than ours, is the Martin B-26 medium bomber. As you know, it has already arrived at a nearly as a single plane against the enemy as the Pacific, and perhaps elsewhere. Now it's been up to other new departures, which cannot be told as yet. The enemy doesn't like the plane at all.

But don't believe that you will lose about all the air developments, and even all the important ones.

New Fighters in Action

You should have seen, before long, about our newest fighter planes, which are coming at the front. The Lockheed P-38 interceptor is being reported, a number of the Republic P-47 Thunderbolt are understood to be in action by now, but nothing has been reported on the Navy's Grumman F6F Hellcat, the F4U. All of our planes have 2,000 hp, making the world's best. They have what their designers think is the best possible combination of all the things that a fighter should have. We have all other new planes, going toward production, not yet heard of.

But not all of the air war news is good. John Thomas C. Harbo, a member of the United States Senate, and in a *Submarine Warfare Post* article that our aviation made strange mistakes when the Jap war ended, and that our defense planes caused their chance at Pearl Harbor and Iwo Jima. And that our submarines bagged as many enemy ships as all other forces combined. His story explained how the British lost two battleships to Jap air attack. The commander knew the odds, but he had got through he could have knocked off Jap merchant ships carrying the attack on Malaya, a devastating

rate. The attempt, the Admiral says, was partial.

Not especially unusual is the fact that, though they are hard-pressed for manpower and materials, the Germans have been able to retain their planes and bring out four new airplanes. These are the ME 109 with a liquid-cooled, 1,500 hp. engine, an improved model quickly following the original (PW 180); a new bomber, Heinkel 177, intended to challenge our high-level bombers; and a Junkers B-24. It is noteworthy that the new Messerschmitt has more armor, three engines and two machine guns, but is not so fast as the original.

The air phases of the war seem to be going better for the United Nations than the surface operations. The score board does not show that we are yet winning the war at any point. But the President and a good many other people are pretty well at second-string government, and it is hard to believe that we are losing the war. Such statements are not only disheartening, they are incorrect. It is true that China and Russia and the British are still taking hard punishment. But when you consider that equipment in the hands of warlike, and that the Allied command, the United States, is getting stronger, you can

hardly say our side is losing. On the other hand, Germany has passed the peak of her strength in manpower, and its gasoline power will get no better in the face of internal dissipation. The Japanese loss by the sea, and it is only a question of time till strong enemies all around the Japanese archipelago will cut off their lifelines with a preponderance of warships and air power. Talk about losing the war will not help us condition the American war spirit, which is still too big around the perimeter, and too narrow in the chest and lungs.

Nazi May Hit West Again

If the Germans get enough to fit the Russian Union up this winter and hold it with a limited force, the Luftwaffe will come back and make a desperate effort to penetrate Allied control of the air over the Channel and Western Europe. Such plans, based on some expert opinion, is that the Nazis expect to hit the Russians, and that even if the Luftwaffe comes back, it may punch England but cannot get the necessary control for an attempt at invasion.

Gen. Sikorski started a hubbub when he said Germany could be destroyed from overhead. Sikorski is no master of grand staff and imagination. He has had much experience with the press, and his statement was no slip of the tongue. He knew well enough what would be done with it. British air officers recognized immediately that they didn't think bombing alone would do the job. High authority in this country didn't say anything.

Air Power Still Underestimated

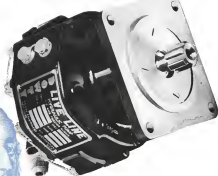
It is plain, regardless of anybody's statements, that our program of tanks and munitions for an Army of 35,000,000 men is not very heady for present war. We can all agree, but strategy is in the hands of the men we have loved for the job. No one doubts they are doing what they believe to be right, and time alone can show whether they are or not.

Aviation appears to be the backbone of the war everywhere except in Russia. Fewer at times believe that aviation would give the direction there if either side had enough of it. The Army and the Navy both still regard air force as an auxiliary to ground and sea operations, while pre-war power men think they can show give, advice by advice, that aviation operations are already subsidiary to aviation and the commodities are use it, or wait.

The Story, which had been already criticized for sending John J. Tamm, the able chief of prosecution, to see with a heavy life, and for not having any chance on the ground board, set its course back a bit by appointing seven old-time war experts to be aviation advisors.



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Financing the Airlines

(Continued from page 21)

\$30,000 Most likely not. Its present stock outstanding aggregates two times \$11,000,000. The market simply would not take an additional issue so large, even if broken up in a few segments. The constant diluting of existing equities by additional stock offerings will eventually result in a negligible factor in cash financing. More importantly, however, sound financial position would be lost against all-advance equity issues for the industry.

The success of any future airline financing, regardless of its form, will be largely influenced by the consistent vigilance exercised by the Civil Aeronautics Board. The board is aware of the influence in this respect and has frequently stated that a sound regulatory policy is essential in order to protect necessary capital in the industry.

Intimately coupled, in an letter of May 11, 1945, replying to the resolution sponsored by Senator Clegg, the CAB attempts to show that the policies have facilitated increasing interest and confidence of the investing public in air carrier stocks. To substantiate this contention, the board presents the Bureau's gross averages of the various industries showing that for the period from Mar. 11, 1935, to Mar. 11, 1942, out of 25 classes of stock, the air transport group showed the largest relative gain with an increase of 314 percent during the period covered. (Note—these Bureau's averages are the same series accompanying the articles in this department.) This is recorded as far as it goes. The board, however, neglects to mention that under date of Mar. 13, 1942, it issued its famed report ordering reduced and restrictive stock compensation for American. This document was mainly responsible for depressing air transport securities to their low point in Mar. 1942, the group average declined in its lowest level since 1929, 1939. This demonstrates the power of the CAB in influencing trends.

The CAB, in its report, further contends that the domestic air carriers have "been slightly outmoded in timing and size expansion." To prove this, a table is presented listing the various stock fundations representing 12 years with an aggregate value of \$16,800,000. Significantly, in this table, despite having the benefit of Paine 1939 filed with 2 and having complete access to the SEC records, the board omits one of the major financing of the period. This was the Transcontinental Control sale, on Nov. 20, 1941, of 75,000 shares of preferred stock having an offering price of \$1,375,000—an unprecedented amount. (Note: It is noteworthy that all new stock offerings since Aug. 22, 1939, in-

terview with the added information of current market prices.

Up to 30 Mar. 13, 1942, domestic air carriers, the CAB has successfully been a constructive force in securing a strong basis for the financial growth of the industry. The following statistics following the Mar. 12 series was announced then, on July 30, 1942, the board reversed itself on the complete principle in setting said rates for Pan American-Grace Airways. This reversal has had a major effect in sending the Bureau's air transport average into new

high ground for 1942, reaching 33.02 on Oct. 2, 1942.

A few dangers to any future airline financing, however, in general in the board's recent philosophy establishing or not rates so as to limit profits to a return of 10 percent on the investment. Such a policy would tend to be restrictive and serve as a retarding influence in the industry. Further, a definite policy on airline securities would be established and some of the available assets in the industry capital structure—what the CAB has tried to

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Graphic Illustrators

(Continued from page 115)

pinpoint, each graphic illustration for conveying clear pictures to assembly line men. But the illustrator also had a multitude of other uses. For example, they are being reproduced in service, overhaul, and repair manuals, for it has been found that they can depict an infinitely greater amount of detail and clarity than is possible through the use of photos. This proves a real boon to the repair man who has never before seen the airplane on which he has been called to work. To him, the graphic illustration is as much of a help as it is to the assembly line operator. So far as is known, Photomats is the first service order which has adopted the practice of using three-dimensional graphics.

Besides, the sketches are of considerable help in transmitting a visual picture to subcontractors who, if they are typical emergency subcontractors, may be working on aircraft production for the first time. Still another use is found in company conferences. Photostatic reproductions of the three-dimensional drawings are bound separately as books which are distributed to the conference members—a much more effective plan than is usually followed whereby tags, maintenance blueprints are unfolded on the conference table. Use of the graphics requires no detailed explanation for clarity's sake.

A fourth, and perhaps even more vital application of graphic illustrations by Photomats is found in preliminary design. The most important benefit that stems from this plan is that the graphic illustrations frequently call to the designer's attention details that might be overlooked in mechanical drawings. The designer, one, at the elementary stage, are clearly the need for design. Two hours of engineering time are saved, five if the changes are not made at this point considerable revision would doubtless be required later.

The graphic illustrator assigned to each work must be a veteran, one who has been around long enough to have a reasonable knowledge of aircraft structure, as well as an abundance of experience. The bulk of the data given to the illustrator by the designer is in verbal descriptions and rough sketches. Almost no mechanical drawings are provided. It is stressed that here the artist, who has learned through experience to rely strongly upon his imagination, is well equipped to meet the requirements.

Today, a year after the graphic illustrations department was established, Photomats engineers and superintendents after the first year's experience to build the department has proved its ability to be the direct approach. The



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high quality and speed of output of the group has more than made this—And what is more significant—the demands on the division have multiplied many times over as its work has passed in a relatively short time for a variety of jobs. In addition to building, or reconstructing, the perfect job which it was primarily established, that of making graphic devices, it has been found that the new department is also of great help in making posters, layouts for the company house signs, colorizing photographs, and on many other jobs for the public relations department. This by-product is especially welcome because of the fact that each work, which normally here is turned out in independent organizations. We feel that by working closely with these men, who are in their own right expert craftsmen, we are getting better results, and put them faster.

And just as the company is looking in on this by-product, so are the artists themselves enjoying the opportunity of having their hands in the kind of work they know best. As Mr. Gervasio says: "These men are creative artists. They need the stimulus of creative assignments, otherwise they'll go stale."

Here's a sample of the kind of contribution the artists make. The Fleet Supply Store has been engaging in a battle of poster propaganda of soap supported by its stores, the graphic illustrations demanded are a pointer the effect of soap opera propaganda and making of exhibits with model. The poster fairly screams: "Keep package out of the soap containers. We can't fight with that stuff, but!" A few flying beaches, as beach has open, dropped a message of efficiency—apple sauce, peach juice, orange and banana punch, lemon syrup, pap, and half-sour sandwiches. The posters will be recycled. The workers took the last and a definite improvement was noted in the very metal before men after.

Other projects which would have been next to impossible without the graphic illustrations department are now in the air.

Water-based Airplanes

(Continued from page 125)

Looking any sort of useful test data, these comments are only what I hope are reasonably intelligent statements (which, in airplane design, are often more reliable than incomplete data). At any rate it can be said now that a hydrodynamic form of excellent aerodynamic shape is possible even if that shape does not conform to the usual, but changing, criteria of the "perfect airfoil."

The effect of water conditions on designs is an important subject which, as

far as I know, has not been subjected to much effective analysis. You hear that a flying boat will "cope with a 4-ft. swell" or that it "backed up in 6-ft. waves"—all of which means almost nothing. Every experienced boat pilot knows that boats have often taken off and landed in apparently impossible conditions and yet got into trouble or even washed up under "heavy" conditions.

This is a big subject for which we have space only for a general outline.

The study of the effect of rough water on winged vehicles seems under three main headings:

1. Folding techniques, which is outside the scope of these notes beyond the observation that it is today too large a factor in reliable waterplane operation.

2. Stability and control of the design which on a different matter makes more sense from its flat water characteristics.

3. The actual forces of water action, separated very difficultly into their vertical and horizontal components.

But first of all, what is "rough water"? The experts think of it in terms of wave length above certain things. A high but short chop, as such will excite waves, may look very ferocious, yet it may have so little wave strength as to have very little effect on the action of the ship in spite of vigorous sloshing of spray. A low but long swell may have a disruptive appearance of seas, yet have such great shore strength as to form the ship into pitching and heaving motions which hinder or delay longitudinal control at critical speeds.

There is, of course, no dividing line between these conditions; there are intermediate conditions, and there are combined conditions such as when a short chop is superimposed upon a long swell. (There are also, of course, complex forms such as cross-waves which might be described as "advanced stage" swells.) However, one point emerges at the start, namely, that wave length is at least as important a factor as wave height. The figure for wave height as a measure of water conditions is used today because, like time for takeoff, it is easier to measure even if it doesn't mean much.

Once we begin to minimize wave length, the study of rough water effects begins to take some sort of shape. For example, it is usually considered that the larger the flying boat the better it can handle rough water—obviously, because if we cut flying in terms of wave height the waves are relatively smaller. Yet practical experience does not always confirm this. Many boats cope as well and better landing and wind speed values, but to present a study will show that one of the principal requirements of hydrodynamic maneuverability in the

(Turn to page 126)

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Power units in Keen Power Cycles, made by J. H. Keen, Inc., 2000 W. 10th St., Los Angeles 14, Calif., are the most powerful units in the world. They are the most powerful units in the world. They are the most powerful units in the world.



Other well known scooter manufacturers using General Jumbo Jr. tires include:



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The Optima Motor Works, Lincoln, Neb.



Powell Manufacturing Co., Los Angeles, Cal.



Best Motor Transport Co., Philadelphia, Pa.

THE "POWER SCOOTER" has demonstrated its worth over a number of years—not only as a pleasure vehicle—but as the means of saving money, simplifying errands, delivering mail merchandise quickly, unobscured.

Today, the "scooter" has gained new importance as a valuable aid to more and faster war production. Thousands are demonstrating that they can run necessary people and needed materials fast, dependably—from factory department to department—and factory to factory.

The success of "scooter" manufacturers long ago standardized on General Jumbo Jr. tires. Actual experience in this instance, fast service has proved to them that the Jumbo Jr. power tire—also wheel combination has the extra quality and strength that brings dependable performance.

General Jumbo Jr. stood up and took it on "scooters" in any type of industrial truck operation. The exclusive, patented design of the Jumbo Jr. makes possible a kind of performance equality by all other industrial power-tires. Available for war orders and for certain essential industrial uses.

For further information, write,

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Tires 8" to 24" overall diameter. Load capacity 100 lbs. to 1000 lbs. per sq. in. 2 1/2 x 8 inch-wide with new wire nylon and heavy duty rubber.

GENERAL JUMBO JR.
INDUSTRIAL BALLOON TIRES



Independent laboratory test found mechanical felt parts are satisfying design engineers as to the ability of felt to serve better in scores of aircraft and machine applications.

Booth's "processible" felt is made in 16 different grades, with ingredients "compounded" to give the color and properties desired for the present or for future machine use. The properties and savings available "Write for the Booth condensed booklet, 'The Technological Felt Making'—The modern felt revolution described, may be a revelation to you."

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steps or half a century of progress since this one was broken into its parts.

We have been at work as a shop, when the future development and employment of water-based aircraft is less a technical problem than a psychological one. We have become so completely and philosophically that the performance of instruments (and hence, their relative usefulness) is taken completely for granted, being technical progress on the point not only doesn't go to first thought, doesn't go to last.

You may think this statement is one frustrated by a recent outbreak in favor of huge cargo flying boats. But please note the "they," which usually means, in technical, something about "you" as big as anything existing. It is a fact, but not dispute that, in our case in which both airplane and flying boat have both been built, the airplane has the better performance—usually a much better performance. The flying boat has so far held its own only while airport and landing gear improvements have lagged far behind, particularly in the case of the flying boat. Hence wherever some useful has been built to build an airplane which would perform because of carrying power, it has usually always possessed a "huge flying boat." You have only to remember such names as, Caproni, Vought, Boeing, Curtiss, Lockheed, and Douglas with its DC-3. These large boats have come to anything, that were once likely to, in spite of being designed, in some cases, by quite competent engineering staffs. All this comes from the old, established belief that, if you build a flying boat big enough, you will get efficiency from it—when the fact is that, if you build a flying boat big enough, you will have no airplane big enough to support it and it will be a waste of money.

If the actual facts are analyzed, as I have tried to do in an elementary form in these notes, it is seen that these factors which previously were flying boat machinery have been or are being to do with size, they are inherent in the "modern" flying boat because of design, and they apply to any scale. This, indeed, is obvious from previous size results. So if you build a huge enough flying boat, the best you can do for it is that there probably will be no equivalent airplane to compete. But we present here, if it will be for the more technical engineer as its reader's preference.

So these are plans to help flying boats are not going to help waterplane progress. They are merely doing an old story as to latent and actual experience from. (Incidentally, several people have asked: what are the advantages of the two half in comparison? The answer is:

water-based aircraft, though it has its own advantages.)

We are not going to get efficiency in large flying boats until we can get it in our own. So it is much more than water to airplane, water is a problem because for water-based craft, when a free form of that many would establish principles of efficiency, as a smaller scale.

To summarize very briefly the technical situation. The poor performance of water-based aircraft is not, as is too often supposed, a matter of the air drag of wings, fuselage, wing floats and other such hydro-dynamic, it is, however, the result of the enormous weight and drag of the vast bulk of the hull. When this problem is dealt with, these other details will rather result in because of complete improvement, since they are mostly the direct or indirect result of having to get proper trim, stability, shock absorption, and reduced water drag with a set of drawings which are too long for the job. These drawings are too big because they are based entirely on the values required to support the airplane at rest on the water.

The design and performance of the modern airplane is based largely on the relaxation of its surface support; there is no reason whatever why parallel results cannot be achieved for the waterplane at a comparatively low cost in weight.

It has, undoubtedly, been suggested that, for three military cargo planes, the huge space of a flying boat hull will be necessary for something like that cargo. It will not. Such cargo will be available in high storage density so that the fuselage volume at a normal airplane which could carry the load would also, at the same capacity of cargo, also provide the required space; there is therefore no actual reason why a boat should be more military capable.

The problem of producing waterplanes equal in performance to airplanes is principally one of finding the right way on its own basis instead of trying to patch up an existing formula, which, on its own showing, cannot obtain satisfactory results. As a problem it is neither too easy, nor too difficult.

In another sense, such as the weight factor, the problem is somewhat more difficult than in the larger sense, partly because of general operating factors such as absolute freedom of the hull and large in the hull, which demands and makes so you can get waterplane shock, as airplanes, will be the equivalent of any other airplanes, and which are effectively not the water with just no bottom, and which is much lighter, then land gear.

Anybody will get these results sooner or later. The sooner we start to try the further ahead we shall be.

The Instruments He Can't See are Important too!



Whenever a plane is flown... be it in a mission of peace or war... the pilot's ability to maneuver his plane, to get the maximum power of the engine when needed, depends to a large degree upon instruments he may never have seen but of no less precision as those he sees in front of him.

These unseen instruments are various types of HALL equipment so universally used in the production or maintenance of valves and valve seats of float operation... HALL Aviation type ECCENTRIC RING WET TYPE VALVE SEAT GRINDERS and WET TYPE VALVE RE-FACERS... Complete information on these dependable HALL production and maintenance instruments upon request.

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Your **READ** Wrench Jaws and Chaser Dies
... at a Big Saving to You

YOU can help meet your tool shortage by using this new service to keep all your **READ** Pipe Tools on the job. Simply collect all your old worn **READ** Wrench Jaws and Chaser Dies and turn them over to your Supply House with order for this Reconditioning Service. Your Jabber ships them to us with parts

from other customers, to save shipping expense, for we allow one-way freight to Jabber on 100 pound lots or more. Reconditioning only means truly standard parts accepted for this service. No priorities decided. Service is prompt. A few days and your tools are ready to use. We receive the tools to inspect them if they can't be made as good as new.



Quick Reconditioning of **READ** Chaser Dies

Turner dies are commonly in groups to recondition conditions. They are then inspected and send back to you under **READ** new parts guarantee.



Quick Reconditioning of **READ** Wrench Jaws

both ends and both jaws are immediately installed in our automatic electric furnace, until new jaws. They are then in the same machine and by exactly the same methods to make new jaws. Jaws are then hardened like new. After final inspection, they are returned to you under regular **READ** new parts guarantee of satisfaction.



Every tool is needed these critical days. Gather up your worn parts now and call your Jabber. This service is available only in the United States.

All **READ** Pipe Tools are sold through Supply Houses



THE READ TOOL COMPANY
ELYRIA, OHIO, U.S.A.

Work-Saver Tools for America's Big Job in 1942

Design Details, BMW 301A (Continued from page 20)

and of water through which cooling air is forced, between the cooling grids and a water tank is a separable pump and the rest of the cooling unit.

Between cylinders there is an overhead ring forming a water passage for the water and also acting as a collector ring for cooling air for the four cylinders. Air from the front fan is forced into the ring from which it passes through "semp-draft" which are riveted to the ring and, when goods are set direct to the cylinder head fins. Final and over cylinders have these "semp-drafts."

Around the cylinder heads and sides of the cylinder heads are elaborately shaped one-piece cooling baffles, the throats of which lead into the water intake collector ring. At the front of each of these side baffles are riveted small fan-shaped deflector baffles for directing the flow air to the rear of the engine.

The chamber alloy supercharger is being mounted in a hole at the rear of the engine, in line having a heavily ribbed magnesium alloy intake manifold to it. Both along the two exhausts together your through into the crank case and across the whole assembly.

The supercharger has a two-speed gear to use the drive to both over-revving being made through a main drive gear with a 16-tooth-operated chain crank case. The supercharger impeller is a little over 13 in. diameter and has 36 blades. It is mounted from the crankcase bearing. Alternate blades have a cut-out under portion to direct the air to the blade gap from the crankcase. The rear half of the supercharger is a good example of the German magnesian casting technology. The rear covers flange house for the governor, main pump, pressure delivery pump and the elaborate 14-cylinder injection pump.

The Gasoline Injection System

This injection pump is introduced in that it is the first multi-plunger high pressure pump built for production in a single form. The pump is made by Friedrich Dinkel and, typical of this firm's products, is real precision engineering.

The 14 radially disposed plungers and sleeves are moved back and forth by a cam ring with three cam drives from the supercharger drive at 1/8 engine speed. Each plunger is moved by a spring loaded inlet cam follower which is in constant running contact with the base of the cam ring.

Each pump plunger-sleeve carries a gear ring at its lower end and is driven

They're Coming in ... *Lights Up!*

Briggs & Stratton is making and selling no more for years electric power fans or any blower fans. They are, however, making, producing with their own Briggs & Stratton electric motors, using their own and Briggs & Stratton. Available light for a wide range and low speed motor. This is but one of some of the products that a Briggs & Stratton motor can drive. Briggs & Stratton motors are being used in all sorts of power equipment, as well as in boats, in homes and in factories.



For the duration, in ever increasing quantities, Briggs & Stratton 4-cylinder, air-cooled motors are being produced only for war and approved civilian uses.

To assist in the conservation of critical materials, owners and operators of Briggs & Stratton motors are urged to give them most frequent inspection and care that normally is given unnecessary need for repair parts. If additional service or parts are needed, go to your nearest dealer or an Authorized Service Station, BRIGGS & STRATTON CO., CHICAGO, ILL., U.S.A.





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... WITH THE *Most!*

GETTING these "fastest with the moosest" is an axiom as important in the warfare of production as on the battle front. That's why, in hundreds of America's highly geared war plants, you'll find P&H Zip-Lifts handling materials beside machine tools, along production lines, in warehouses, loading scenes, etc. They're saving time, manpower—helping get America there first with the most!



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250, 500, 1,000 and
2,000 lbs.

It's a small, new rope-climber hoist with full magnetic push button control with strong capacities of 250, 500, 1,000 and 2,000 pounds. Full hook or trailer attachments are interchangeable. To suit the war effort, qualified design plants can depend upon P&H's fastest delivery dates.



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in the gear—with six flat-sided wings—slides the plungers, rotation of the gear rotates the plungers starting the shaft angle of the quantity material which is helically cut into the head of the plungers. The whole setup is similar in design to the familiar Bosch diesel pump.

The quantity control mechanism for the 14 plungers is singular. As stated, each plunger there has a gear at the outer end; this gear and other plunger gears are later-matched by a circular gear ring which rotates each plunger. Guided to the place is made by a short shaft geared at one end and meshing with the top plunger drive gear.

Gasoline is fed to the injection pump plungers through a circumferential cone in the pump casing from the supply pump located close-by on the rear wiper changer case. Provision is made for any accumulation in the line to be diverted through a series of small passages to an air collector located in the injection pump body within the circumference of the rear of plungers.

Plunger drive shafts, hollow steel, are fixed together. Each plunger head is helically cut and geared to provide a variable angle face to the intake and cut-off ports in the sleeve to allow for varying throttle position. These pump are cleaned as provided with a cleaning type non return valve on the delivery side. This is in no way similar to the famous Bosch Afton valve but no doubt fulfills the same purpose as far as it is necessary in a lower pressure injection system.

The injector which is located between the valves in the cylinder head is of extremely design. In contrast to Kerosene Spray design, the injector orifice is of the open type and the head of the nozzle closely resembles the Bosch pump type injector. Diameter of the hole injector orifice is .0005 in.

Directly under the injector body at the nozzle and the nozzle diameter is increased and a three-start sharp cut thread is used both as a fuel passage and also to impart a swirling motion to the gasoline when entering the cylinder. The annulus of the injector device follows standard practice. A small needle filter is incorporated within the body of the screw-in needle seat plate located at the top of the injector.

Lubrication System

The lubrication system in the BMW motor is interesting in view of its simplicity and thoroughness. No fewer than six pumps are used—to a pre-mixer and four separate pumps.

Belonging to the supercompressor type pump showing this lubrication system beyond readily shows the oil flow.

The pump at the discharge delivers

THE MARQUETTE ALL-WEATHER WINDSHIELD WIPER

Engineered FOR ALL TYPES OF AIRCRAFT



OUR FIGHT FOR FREEDOM GOES ON...

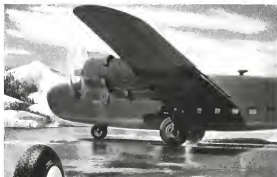
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STOPS 'EM ON ICE

One of the slipperiest problems up North was the landing of 25-ton planes on glaciers or hard-packed snow without an expensive crash-land. The ice formed a perfect lubricant for rubber tires regardless of the tread design—turned the tires into dead wheels, sent the plane into the next county.

This problem that had to be solved was put up to United States Rubber Company engineers.



Result: a tire that has turned ice fields into landing fields—the U.S. Royal Ice Grip Tread covered with rubber lumps, the outside rows of which have crimped steel "bottle caps" embedded in them. These sharp metal edges bite into the ice and snow when the brakes are applied and, it is reported, stop the plane as quickly on ice as ordinary tires do on a dry concrete runway.

Do you have a tough airplane tire problem? There's a "U.S. Airplane Tire engineer near you ready to help. Use him!

ONLY "U. S." HAS THESE EXTRAS

1. **IMPROVED RUBBER TREAD**—A tougher, more resilient compound for airplanes.
2. **SAFETY IMPROVED RADIAL GOOD**—A lighter, more resilient, explosion resistant material with automatic impact resistance and resistance to high compression.
3. **FIELD AIRPLANE TIRE SERVICE**—A force of "U. S." field engineers in every part of the country is promptly available for inspection and trouble.
4. **"U. S." ICE GRIP TREAD**—A trend of revolutionary design and performance for snow and ice covered landing surfaces.
5. **STEEL BEYOND CONSTRUCTION**—Conductive rubber construction grounds static electrical charges upon contact with the ground. This safety feature is available on all U. S. Royal Aircraft Coaxials and auxiliary wheel tires.

BORN IN EVERY "U. S." TIRE — A "U. S." TIRE FOR EVERY PLANE



UNITED STATES RUBBER COMPANY

AIRCRAFT TIRE DEPARTMENT • 4000 E. JEFFERSON AVE. • DETROIT, MICHIGAN

at 375 lb. per sq. in. and a special check valve is provided between the outlet and the inlet side of the pump to prevent excessive build-up in the suction system. The pump 3 delivers through a rotating vane type filter driven by gears from the pump. Pumps 4 and 5 are coupled on the delivery side and the common outlet is fitted with an automatic pressure control valve which maintains a constant oil delivery when built at a little in excess of 200 psi. This valve also serves to provide excessive oil pressure when the motor is idled.

There is a breakoff through a pressure-releasing valve to the valve housing which is lubricated at much lower pressure. The valve gear is actuated by the pump 3.

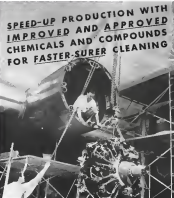
Discharge and suction from the whole of the front of the engine including the fan drive gear, propeller reduction gear and front end sprocket gearing are scavenged by the two pumps 2 and 3. Discharge from the lower half of the crankcase and the accessory drives located on the rear supercharger casing are all drained and scavenged through pump 6.

Very thorough arrangements have been made for draining and heating all of which are taken from the exhaust system. In the burner 11111, the effect of excess of this heating set up in blow-by is shown in a plate on the instrument panel giving the pilot instructions as to what to do when the engine and other parts get too hot. Air is fed across the fuel air head pipes in such places as the water leading edges, the front tank compartment and the engine. A special specially drilled tube runs round the supercharger cooling cover through which hot air is distributed once the wind shield.

Specifications are as follows:

- Intercooler pressure—1,480 lb./sq. in.
- Maximum engine power (continuous)—1,280 hp @ 2,500 rpm @ 14,500 ft. @ 2.5 psi manifold pressure.
- Maximum power (emergency)—1,580 hp @ 3,500 rpm @ 14,500 ft. @ 4.0 psi manifold pressure.
- Normal engine (emergency)—1,350 hp @ 3,180 rpm @ 10,000 ft. @ psi manifold pressure.
- Maximum power for taking for 2 min.—1,580 hp @ 3,500 rpm @ 4.7 psi manifold pressure.
- Wing—6.15 m.
- Span—6.15 m.
- Wing—2,020 mm.
- Overall diameter of engine—50 in.
- Overall diameter of cooling—50 in.
- Length—50 in.
- Propeller reduction gear—950 x crankshaft speed.

(Turn to page 206)



SPEED-UP PRODUCTION WITH IMPROVED AND APPROVED CHEMICALS AND COMPOUNDS FOR FASTER-SURER CLEANING



ANODEX Original REVERSE CURRENT PROCESS AND COMPOUNDS proven by many to be the fastest, safest and most widely used for cleaning metal, metalizing and chemically clean prior to finishing or plating. Especially recommended for steel parts of airplane engines.



METEX specially mixed AERO COMPOUNDS prepared for the faster, more exacting requirements of the war industry and compounded especially for the cleaning of Aluminum and Alloys . . . Proven to be faster and better for aluminum plating.

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REX-FLEX

Stainless Steel Flexible Tubing

**SIMPLIFIES AIRCRAFT ASSEMBLY . . .
MAKES TOP PERFORMANCE DOUBLY SURE**



Left Shows are Typical Post-War Aircraft Assemblies

Rex-Flex Stainless Steel Flexible Tubing combines the high fatigue value and the heat- and corrosion-resistant qualities of stainless steel with extreme light weight and flexibility. Rex-Flex is available in multiple plenums, available in long lengths, and can be "banded" into place in cramped installations, eliminating joints. Simplifies and speeds up installation of air ducts, exhaust connections, blast tubes, heater ducts, power plant accessory parts.

Rex-Flex Stainless Steel Flexible Tubing is available in free wall forms, all of which can be combined in a single one piece length, with straight walls and corrugated sections at desired intervals. Sizes 1/16" I.D. to 5" I.D. inclusive. Made of 18-8 (Austenitic) Stainless Steel. Fittings are attached to tube ends by circular resistance seam welding. No flux, no flame, no quenching—producing absolutely tight, hermetic airtight assemblies.

REX-FLEX is a production item originated to meet certain requirements of industry at peace. Fortunately REX-FLEX, as well as our other established Flexible Metal Hose products, have proved vitally important to our country at war. REX-FLEX is offered at a typical result of the engineering initiative and productive resource of this company. We welcome further tests of our ability to match our services to your needs.

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propeller—four speed
low ratio—5.00 x crankshaft speed
high ratio—3.96 x crankshaft speed
Forward cooling fan—1.12 x crankshaft speed
Reverse blade constant speed propeller—12.0 diameter
Sprocket diameter—13.0 in

(For details on the HSW RSD engine installation in the Pease Wolf 180, see *Aircraft*, October, 1942, page 123)

Cooperation for Victory

(Continued from page 91)

Curran Wright Corporation, by cooperation with subcontractors, has not only the men required in natural numbers but also the men required in skill. The men are experienced in aircraft work in the industries of their own trade. Material which is readily available, developed by Curran Wright has been turned over to subcontractors to help them speed production of essential war goods. Men sent by Curran Wright are given exhaustive training in aircraft production through a two to five week course. Instruction from the front often sent them is severely limited by the design or testing process they do not know. Curran Wright has only turned through hand and experience. But when the men at school return to their respective companies to get to see what Curran has taught them, results are immediately apparent as the previously unskilled total of men making up the United States.

It is apparent even to the most skeptical observer that the American aircraft industry is looking for subcontractors and, because so well and so quickly, that the men so completely that the resources to the field of aviation will be able to compete with old established aircraft resources after the war. But it is also apparent that the aircraft industry is not waiting about post-war conditions until after the war is won.

United Aircraft Corporation, including Pratt & Whitney, Hamilton Standard and Propellers and Wright Sikorsky, is also preparing fully with subcontractors to teach them everything they can experience. At Pratt & Whitney, at an average, employees of business have spent a total of 30,000 man days or 100 man years to learn how to build engines when they return to their own companies. At Hamilton, more than 300 employees of business, and other companies, have spent a total of 60,000 man days in training and study. At Wright Sikorsky, 20 employees from manufacturers and subcontractors have taken a six-week training course and given for additional course work.

(Text to page 92)

Walter Snow Fighters

HANDLE ALL AIRPORT SNOW CONDITIONS!

(Deep Drifts . . . Heavy Snows . . . Light Snows . . . Icy Formations)



Official tests* prove WALTER SNOW FIGHTERS clear greater areas—faster

AIRPORT snow clearing methods "as usual" will not suffice in this winter of war emergency. You need the most modern, powerful, specially designed equipment available . . . WALTER SNOW FIGHTERS . . . to keep runways open and safe for continuous air traffic.

The exclusive Walter 4-Point Positive Drive gives Walter Snow Fighters their great power and traction to blast through deep drifts and to pull steadily on icy surfaces. To meet all conditions, these units are available with specially designed offset V-Flows, Speed Flows and Levelling Wings for deep snows; with pressure center scrapers and sand or chemical sprayers for hard-packed or icy formations.

The prowess of Walter Snow Fighters, demonstrated for over 25 years on the highways of America and Canada, is proving just as outstanding for airport snow clearance. Write for detailed literature.

*U. S. Army and Navy—Royal Canadian Air Force

No Snow can Stop THIS Combination!

Snows, hailstorms, and ice are no match for the 3-ton, 175 h.p. model FG65 Walter Snow Fighter, with Offset V-Flow and Side Levelling Wing, powered with 175 h.p. auxiliary engine. This unit clears 16 feet widths at average speeds of about 50 m.p.h. The great plow "yours" the snow, while the Side Wing levels and dispense snow banks. Side Wing adjustable to any depth of snow.



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FORGINGS COME FIRST

Forgings are vitally essential to the war effort because airplanes, tanks, ships and guns must be built in "withstand the unpredictable" ... for which specification there is nothing to equal the strength and durability of the drop forging. * Before the cutting and grinding machine tools bring these parts to their final microscopic perfection, they are first forged to close limits, by tremendous impact between steel dies, in great drop hammers, such as those bearing the time-honored name of CHAMBERSBURG. Metal is saved, time is saved ... and Victory brought closer ... by the speed, power and accuracy in Chamberburg Hammers.

CHAMBERSBURG ENGINEERING CO., CHAMBERSBURG, PA.

The Cecostamp is an expert stamping machine of powerfully flexible control, designed by Chamberburg Engineering Company especially for the aviation industry.

THE CECOSTAMP
Aircraft and other thin metal parts of high strength alloys are formed quickly and without distortion in the Chamberburg CECOSTAMP

CHAMBERSBURG

HAMMERS • CECOSTAMPS • PRESSES

(Continued from page 386)
Other replies, posted at random, show that Glenn L. Martin Co., Brewster Aeronautical Corp., Wright Aeronautical Corp., Boeing Airplane Co., Ford Aircraft Corp., Lockheed Aircraft, Inc., Consolidated Aircraft Corp., Grumman Aircraft Engineering Corp., Ryan Aeronautical Co., Jacobs Aircraft Repair Co., Vought Aircraft Corp., American Aircraft Corp., Hawley Aircraft Co., McDonnell Aircraft Corp., Cessna Aircraft Co., Waco Aircraft Co., Taylorcraft Aviation Corp., Stinson Aircraft Division of Taylor Aircraft, Inc., and other aircraft manufacturers freely admit. However, sub-contractors and others every facility for teaching their workers quickly and efficiently how any part is normally made. In other words, every detail of manufacture is placed in the hands of what in normal times would be potential because tends to help them master plus production.

Methods very in training personnel by established aircraft companies for other concerns that may come day present competition. That if the aircraft industry custom dies, it dies, there is no shadow in shadowing such men. Some are trained in the airplane company's own plant, others are taught in their own city or plant by foremen and other technicians trained by the aircraft concern. Text books are distributed, equipment is loaned. Even women are instructed by all-line airplane and engine companies how to perform tasks for inspection and sub-construction.

Many of the companies replying to the questionnaire reported that they also taught members of the American and United States' armed forces in the maintenance, repair and servicing of their products in the field. Martin, among a group of others doing similar work for the Army and Navy, reported that in March, 1942, a program was launched to train 500 men from the armed services. This schooling has increased to a rate of 600 a month, or about 600 men every twelve days. The men are stationed at the Martin plant for 34 days, 28 of which are devoted wholly to instruction. The men live in dormitories and barracks at the plant, and are paid full wages.

Consolidated Aircraft, from the other side of the country, reported that it had equipped a camp site, known as Camp Center, and had begun the training of 600 Army men per month, learning 36 instructors and much equipment. Paul & Whitney, as an example of engine manufacturers, operates a special school for commissioned personnel of the Army and Navy, and has trained 575 men in engine and propeller service. P & W has also selected military trainees from the United States and

(Turn to page 392)



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TYPE S
Operating Wotage 0.012

Sensitive RELAYS

Sensitive in their ability to operate with minimum wattage.

Ruggedly constructed to withstand the vibration and shock of Army and Navy equipment.

Meet all Army, Navy and CAA specifications.

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MAN OF ALL WORK

THIS field of the optical engineer knows few boundaries. Naturally he is part and parcel of such sciences as astronomy and photography, but would you expect him to play an important role in a missile plant, a pump factory, the building of houses, or the discovery of defects in boiler tubes? There are but a few of the hundreds of assignments which Perkin-Elmer engineers have brought to a successful conclusion.

Today we are doing our bit for Uncle Sam. Precision manufacturer of optical instruments and systems for Army and Navy needs has our whole attention. When Victory is won, the development and manufacture of new measuring devices, new control of industrial processes, new tools for research sciences, all will become of even greater importance than ever before. Then The Perkin-Elmer Corporation will stand ready to serve science and industry again, through the science of optics.

If you are already thinking ahead to post war necessities, you may want to know more about how optical engineers could be of service to your business. If so, we shall welcome your letter.

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MANUFACTURERS OF PRECISION LENSES - PRISMS and MIRRORS

OPTICAL DESIGN AND CONSULTATION

(Continued from page 29)

South American countries. The Wright Aeroquest Corporation operates a service school in which mechanics of the U. S. Army, Navy, Coast Guard, Marines, Ordnance Department, Armed Services and Air Forces in general of the United Nations, as well as commercial airlines, are trained in the special maintenance, repair and overhaul of Wright Cyclone and Whistlers. This school, founded in 1938, is the oldest service school in the aviation industry. Wright reported it has moved to new and larger quarters five times in keeping pace with its expansion.

Boell Aircraft has established a school for the instruction of Army Air Forces technicians in the servicing of Army P-40 fighters. Since April, 1943, approximately 1,200 men have been graduated from the intensive course. Boeing's three-engine plant reported that it was making extensive plans to train sections of the U.S. armed forces in maintenance, repair and service of their equipment.

Significant among the proofs of industry inspection was Boell's statement that "substitution any diameter or size methods of speeding up production. They tell us, and we, in turn, when we make a discovery, tell them." Boell further reported that considerable back-sold information was exchanged in an effort to speed production. But it was also pointed out that in some safety and security, such required information was released only through channels set up and approved by the War Department.

Finally, on the western fringe of the Midwest, where aircraft manufacture during hours with two other companies—Crown and Beech—in its community. And although, in one instance, one company is a joint venture and the other two are subsidiaries, Beech reported that all three companies were working together without prejudice or rivalry, except on the subject R&D, where even the cost of doing business was of significance and discussion first.

The survey further disclosed that Boeing feels that other and smaller companies should be invited by the government through award of contracts to make strength parts so that American business is gotten closer to heart. In other words, Boeing strongly suggests and its desire the other companies, not only as well as others, to give a share of the business being placed with the aircraft industry by the services.

Wright Aeroquest also reported that it substantiated the work is many cases where it would be possible for the company to save time by manufacturing the same parts in its own plants. (Turn to page 385)

Announcing

ANOTHER "WEAPON FOR PRODUCTION"

THE "MX" WHEEL

Pioneered and offered to industry exclusively by Carborundum

1938 that a year old, the "MX" Wheel is already making a name for itself as a "Weapon for Production." It is a free-cutting wheel capable of light stock removal and high peck-holding action at the same time. It requires but little pressure. It is used dry, since no coolant is required at the low cutting temperatures developed. And its flexibility adapts it particularly for use in banking and pushing out-of-the-way places on simplest engine parts and similar work.

Some typical applications are indicated by arrows on photos below. They include breaking down bevels or sharp edges on gear teeth, finishing and polishing cylinders and hardening flat surfaces, tapered areas and various types of undercuts.

These new wheels are fabricated as a fine variable degree of hardness and flexibility, in six grades of hardness. They are made in sizes 50, 60, 120, 300 and 350. Diameters range from 2" to 12", and thicknesses from 1 1/2" to 2". The complete information on request.

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machines of war which can as readily be converted to the demands of commerce.

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CHANDLER-EVANS CORPORATION

MANUFACTURERS OF AIRCRAFT CARBURETORS, FUEL PUMPS AND ACCESSORIES

(Continued from page 100)

Wherever it has been possible, however, for the subcontractors to learn how to make parts that will meet quality and standards, with assistance by Wright technicians, subcontractors have been set in a spirit of full cooperation. The subcontracting procedure also allows Wright to use laboratory and shop space for manufacturing those parts which require a great deal of skill and which could not be handled by subcontractors.

These typical examples are indicative of the scope of the ideas and work being carried on by members of the aircraft industry throughout the country in extending every assistance to civilian and armed personnel to find not only more and better aircraft may be produced quickly but that they may also be rapidly serviced and repaired in the war zones.

Four major car manufacturers, General Motors Corp., Ford Motor Company, The Studebaker Corporation and Packard Motor Car Co., now engaged in aircraft work under license, reported that they also were exchanging information with other companies in the industry concerning many subjects, including the building of new fuel supply pipes, and most are engaged in looking members of the U. S. armed services in maintenance in the field.

The service provided plentiful examples of how laboratory studies and engineering data had been evaluated even through many years and much money had gone into their development for private use. That is, for private use before Pearl Harbor. The maintenance, of course, superseding the former and exchange of well highly industrial and important information, but with new lines made received from Washington, aircraft companies are not holding back anything from anyone who may help increase production or evolve an improved product.

The aircraft industry has subordinated whenever and wherever it could, without regard to whether an old established airplane manufacturer thought he might do the job better or at a profit to his company. While there is an sacrifice of quality, there is more effort on the part of the industry to give as much work to "outsiders" as is consistent with the high standards of airplane construction. And the industry's profits is ignored. The great majority of the aircraft industry replied that making money was a secondary consideration if a subcontractor could do a portion of their work and do it well to help speed the final craft on its way.

In the question whether any manufacturer had had the occasion to turn over materials to some other company, and or otherwise, to take them over a short-



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age when the same stock might be used to manufacture "Spares." 90 percent of the companies supplying stated that they had often reused spare materials to other aircraft manufacturers. Either the stock was sold outright or loaned, and when the borrower returned from his own source what he had had to seek from another aircraft builder, the loan was promptly repaid. Again, the loaning and rebuying of such streams material has been in full accord with MFG policy, and surplus materials are registered with the Aircraft Reliability Unit at Dayton, Ohio.

As another random example of how the American aircraft industry is co-operating with its fellow members and outside organizations is a report in *Aircraft* magazine. It states that one of its producers completely eliminated a manufacturing's worst problem similar to one produced by Arneson, asked for help in connection with a cutting problem. One manufacturer had no trouble in supplying his equipment through a well-known dealer. But the other got reports that his product was slightly damaged upon arrival at the scene of action. Arneson promptly provided full speed recovery on its pending procedures in order to safeguard the product of its one-time competitor.

The problems of suppliers, regions and companies reported that they had seen in their own plants considerable examples of what recently occurred to the American Propeller Corporation, a newcomer to the aircraft industry. This company, like many others, changed in the ways of producing standardized equipment, received help on a method of housing files is made from a computer that is moved later, a method of handling of tapping of a computer to a short end to production. But, shortly thereafter, American Propeller received the favor by developing a method of grinding blades which has offered important savings. This year and late in the aircraft industry and its newly designed knowledge and which handling is almost universal. Mutual respect and confidence have been greatly increased through the wholehearted cooperation of the industry, as is evidenced by the examples which have and some has permitted as to be.

Other sources in *Aircraft* magazine showed that members of the aircraft industry were not so about solution that other companies are considered outside the fold had helped them in building a better product and in some instances, in building it faster. In other words, there was no hostility as the part of some companies to give full credit where it was due. This actually reflects with real abundance on the aircraft industry itself due to outside cooperation when the same stock might be used to manufacture "Spares." 90 percent of the companies supplying stated that they had often reused spare materials to other aircraft manufacturers. Either the stock was sold outright or loaned, and when the borrower returned from his own source what he had had to seek from another aircraft builder, the loan was promptly repaid. Again, the loaning and rebuying of such streams material has been in full accord with MFG policy, and surplus materials are registered with the Aircraft Reliability Unit at Dayton, Ohio.



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some are able to help produce better aircraft today, it is obvious that they must have been done with precision and accuracy in the interests of semi-aerial manufacture by the old-time companies which, in positions, were the only ones which had any knowledge whatever of these subjects.

Many of the companies relying on the quotations reported that they consistently actually met with other concerns in various production schedules and methods, to produce specific information of several value not to hold level but important round-table discussions on how to build better aircraft faster. Such meetings are held short because all parties to them are so rushed with production. But such friendly get-togethers are certainly indicative of the broad effort to help the other fellow, and to accept the assistance in fact if it will help speed the way to a momentous conclusion.

Design and Combat Performance

(Continued from page 80)

These characteristics have to do with fighters as airplanes, but airplanes are also weapons. Good military history of a fighter plane is the story, for so the last analysis no combat ship is better than its armament. It was the edge which the right 30-caliber guns on the fighters and Mustangs, plus slightly higher speed than the Mustangs and Mustangs, which was in large part responsible for winning the air battle of Britain.

Today only 30-caliber machine guns are absolute necessities, and most modern fighters have combinations of two or four 30-cal. guns with two in four or more 30 or 30-cal. machine guns. Instead of these conventional armaments, some fighters have four 20-cal. guns—Hawthorne 16, Spang 16—or six 20-caliber machine guns—Hawthorne, Spang. This additional fire power is necessary owing to the greatly increased vulnerability of modern bombing planes, with their higher speed, rugged construction, jock-proof machine tanks and armor protection. The heavier 30-caliber machine guns firing 800 rounds per min. are much more effective, and at greater distances, than the rate caliber 30's which fire at a rate of 1,200 rounds per min.

American engineers report on the whole favor the 30-caliber gun, while most of the British, Germans and other foreign military experts use combinations of the 20-cal. cannon and 30-caliber or 37-mm. machine guns. This constant demand for more fire power increases the weight, and thus reduces (Turn to page 385)

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speed, especially the rate of climb.

Besides these fundamental characteristics of speed, climb, and firepower, fighter planes must have other performance features. Proven to increase reliability, both for the pilot—to get the plane into firing position—or in the potential menace of infinite to combat.

A good fighter must have clear visibility to enable the pilot to see the planes in all directions to discover his approach and avoid being surprised. It must have good handling qualities for landing and take off from small fields. It must be of simple, rugged construction for easy maintenance in the field, a prerequisite in war, and ground fighter planes can be used in any area at all.

These qualities have simply to do with what has become known as the "fighter's" fighter, and ultimately in strategic wing attacks. For protection of friendly aircraft in close-range operations by destroying the enemy's fighters, or providing an airfield for land force operations, fighter planes are used. (It should be noted that although the "P" designation remains, the term "pursuer" has been superseded by

"fighter" as more generally suitable.) Another function of the fighter plane, however, is to counter bombers and heavy bombers. As yet no country has been able to satisfactorily solve the problem of providing a fighter plane with sufficient positive response to give a range of, say, 2,000 m. (and this same a radius of bomber action not more than 900 m., or 40 percent of range), without sacrificing such primary characteristics as speed, climb and maneuverability.

It will be recalled that in the last week our scouted Fieser by our No. 10 B-17s. They were escorted by B-17s and A-19s in the Pacific. These attacks, with eye witnesses in the British in the possession of available previous knowledge, were all short-run affairs. In a longer run over the North Sea a few days later, an even in the lighter aircraft based back to England the last day of the storm. Fiesers were attacked by a swarm of Fieser Wolf and Messerschmitt high altitude fighters. Yet, our Fieser severely damaged, but all returned safely to base after dropping bombs on their targets; these German planes down in three and none others destroyed or damaged. More importantly, our Fieser have been shown to be B-17s and B-24s.

All of which characterizes the two types of present long-range bombers cannot have fighter superiority all the way. It is when the escort fighters leave that trouble begins and is likely to increase as the mission flies further into enemy territory. In other words, at the very close range, the fighter protection is most needed it is not available.

The other point is likely to make history. This incident, backed by scores of similar examples of B-17s in the Pacific area and an increasing number of instances of British Stirling and Liberator, proves that when an escort program has been made in the last year or so toward the end of a heavy bomber is back after itself independent of fighter escort. Over and over again these bombers and our two-engine Douglas A-20s, Martin B-26s and North American B-24s in every important theater of operations have demonstrated that their speed, heavy fire power and steady construction are more than a match for enemy anti-aircraft and fighter opposition. The pay-off to date is a B-17F which returned with two engines out of operation, tail surfaces almost shot away, riddled by nearly 1,500 bullet holes. In the first six weeks of action over Europe, Fieser captured shot down 80 German fighter planes. Only two B-17s were lost.

The average initial range of British and German single engine fighters is (Data to page 311).

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(Continued from page 308)

600-750 mi., with a radius of action of 500 to 550 mi., or 70 percent. In heavy action, as a ground observer, it is considerably less than this maximum figure. According to *The Aeroplane*, advanced air supremacy was hardly to be achieved with present equipment. *Warplanes and Weapons* beyond a radius of 75,000 mi. Most American fighters and the Japanese have a maximum range of about 900 mi., the P-51 boasting considerably further. To increase the range for ferrying or strategic purposes, jet-powered fuel tanks have recently been provided. That the difficulties of a genuine long-range fighter are not solved, and there are obvious advantages in having a fighter plane with sufficient qualities together to stay in the air several hours, a partial solution will continue to be found in the use of fast, heavily armed, long-range bomber fighters, like the formidable Messerschmitt 150, tough, speedy Douglas A-26 or the powerful British *Bombfighter*. The latter two incidentally, are far and away the best night fighters now in operation, a highly specialized job in itself.

Then the fighter, with all the conflicting qualities of speed, climb, dropness, maneuverability, visibility, ease of handling and maintenance added up, and with range thrown in for good measure, becomes more of a compromise than any other airplane type. The Army Air Forces avoid the design of a new type to satisfactorily as a result of a new problem based on unaccounted general specifications. Most is measured in terms of: (1) Performance, including speed, range and ceiling, 300 mph.; (2) engineering features, including structure, armament, powerplant and equipment installation; and maintenance, 300 points; and (3) military features, including ground visibility, landing and takeoff, arrangement of guns, etc., 300 points.

The few people realize that many of today's fantastic military expenses are the result of tried and proved designs brought in six years or more ago, badly improved as in speed, climbing and dropping but still essentially the same craft.

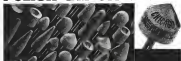
In the fighter class the best examples are the *Mustang* and *Spitfire*. In 1944 the British Air Ministry issued a specification for an airplane fighter with 14 in. range at full throttle (The knock-down, drag-out fight to get the first 300 mph into the specifications was something else again. Such heavy armament was outlawed in these days, but the monstrously designed *Firepower* then provided saved England in 1941.) Using the *Rolls Royce Merlin*, both fighters were test-driven in 1936, even into limited production in 1937, and

the first squadrons were outfitted in the summer of 1938. The *Mustang* had a top speed of 355 mph., and the *Spitfire* 335. Improved versions of the *Mustang* and *Spitfire* have more than kept pace with the demands for more production, and still maintained the power, as the newest models are due to test as fast as the originals and, in the case of the *Spitfire Mark V* the original altitude has been lowered.

The German *Measchmitt 109-328* was brought out in 1936 and made initial production in 1937, its first design having been largely influenced by and

cocked experience gained in the Spanish Civil War. The series is one of the fastest European fighter planes. This model set the seal on the wingman with retractable landing gear as the lighter type of the monowheel failure. The *Me 109* was originally designed for an engine of 524 hp. and was the first fighter to use a 58 mm. shell cannon firing through the propeller hub. Without material change of design the power plant has been successively stepped up to 800, 1,000, and now 1,250 hp., in the 109F. These successive improvements brought the original speed

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1940, good production was reached by mid-1941, and it was then in use on various fronts during spring of 1942. The four-engine Republic P-48 was test-flown across the country on February, 1939, at about 35 m.p.h., taking over 400 m.p.h., while crossing the Appalachians. It has an official NACA rating of 400 m.p.h. at 10,000 ft. However, it was thought to be too heavy—weighed seven tons—and an R-48 2,000 changes were made down to the model P-48B, which was in good production from late 1941, and in use by late spring of 1942.

The Republic P-48 is the first American fighter designed from the outbreak of war to see action. Based somewhat on the Republic P-43, the only Army Air Forces fighter type using a radial air-cooled engine, the Turbo super-charged P-48 design was completed in September, 1940; the prototype was test-flown in May, 1941; improvements made and limited production followed by the spring of 1942. The advanced model is coming off the line at the plant factory in good volume and two other plants are now going into large-scale production.

These three fighters in all is the Curtiss P-40 series, went through the usual sequence of design, development, exhaustive tests, amount of construction for production in quantity, then tooling-up of factories. The Curtiss P-40, tested and most powerful of its type in the air, broke the sound barrier by breaking up for quality production first on the shores of Mexico and a working large number. When the first P-40 flew in late November, 1940, it was a production model and several others were nearly ready. It is now well known that it landed too fast, and there were the usual bugs to be worked out. This has been done at least two full years now, and now the plane is doing its double duty as a diving bomber, doubling as one of the world's fastest, most hardy, toughest bombers in the service at Midway and the Aleutians.

Other planes are now coming along on this development plan, as our good battle has been going on. Some of these have already been test-flown and will be in production by next spring and, speaking generally, the speeds, loads, loads, fire power, range, and range of these new fighters and fighters will be worth taking. A principal factor in this stepping up performance is the improved engine, with or without the use of turbo-superchargers.

Looking of the Record

When all is said and done, however, the end test of a military airplane is (Turn to page 318)



Serving with the Cloud Freighters . . .

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SLEEVE TYPE BEARINGS

(Continued from page 218)
do need to combat. Do lightning knock-off enemy fighters and bombers, or do they get knocked off? Do bombers get through in their targets, drop their loads accurately, and get back in to do it again, despite enemy fighters and anti-aircraft opposition? On the whole, so far as this way, the standard record of American planes has been good, and it is getting better fast. Our heavy bombers have turned in amazing performances, and the new B-27Ps and B-24Es in large-scale peacetime production have been further improved with far greater bomb loads and flexibility in attack range and load. Our medium bombers are being pushed for their speed, striking power, and high degree of maneuverability. The A-26s and B-25s are powered by Wright 14-cylinder Cyclones of 1,700 hp, and the B-26 by Pratt & Whitney Double Wasp of 2,000 hp. As a matter of fact, except the positively reliable Douglas DO-24T-10, powered by two BMW 802 18-cylinder 4,000-hp radial, there are no medium bombers anywhere to match them.

In the fighter class it is admitted that for high altitude work we have not yet been able to match the best fighters of Britain, Germany and Japan, but the high-flying P-38 and P-47 will soon be in wide-scale service, and on the basis of tests and operational reports in date should amply take care of those "gypsies." As a matter of fact, the performance of the P-38s in the Atlantic and the southwest Pacific indicate that their speed, rapid climb, high ceiling, and terrific fire power are just what the doctor ordered to rub the itch all the way East, and the combination of quality, together with a much longer operational range than the Spanish, should prove equally effective against the Focke Wulf 109 in the European area. In the lower levels, where much of the fighting will take place, our fast, well-armed and well-protected P-50s and P-40s are shooting down enemy planes in all styles, in some cases at a better than 5-to-1 ratio. The biplanes are already pleased with the North American P-41, which not only handles beautifully and is easy to service, but is able to perform the speedy Spivey at levels below 30,000 ft.

In the widely scattered theater of operations, supply and service is a vital consideration, and our rapidly expanding world-wide air base under the Air Transport Command, and our extensive network of the Air Service Command's overseas facilities have become so important in any of the fighting outfits. The ability to change bases, and work in really unusual battle-proven theaters is a test for our American air-

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line of reliable quality production, avoiding the danger of aircraft's original wire insulation breaking or degrading. There are indications that the Navy has corrected that to some extent in the P-50-100 fighter and D-2070-1 is also built in operation about a year with 1,000-ly. Some. These two airplanes, designated P-50-100 and D-2070-1, may well prove to be aviation airplanes for a place in our list of the world's "best" planes. However, new American designs, built at home, and British models should be in operation as soon as these fighters' planes, and there is little doubt that the quality of our military aircraft will continue to be improved. Already, we are ahead in a number of practical tests and this advantage will be further increased. Incidentally, in our selection of the "best" planes, the main point of the article should be kept in mind—a particular airplane is "best" suited for its design purpose. With out a reason in mind, comparison between planes are frequently unfair. To give one example, the heavy bomber category it may be fairly stated that the British Lancaster is "best" at the moment for very heavy night bombing of Germany, but not for that role to take account of the amount "best" the world record of the Boeing B-17 and Consolidated B-24 will be in this category by a majority of aviation enthusiasts.

Our country has a number of aviation developments, and the more the quality calls for more and still more research. Air power is today proving a decisive factor in many of the fighting fronts, and will eventually lead the way to victory. But victory alone is not enough. Peace and goodwill are the only real goals, and we have again in power men who see the way.

Side Slips

(Continued from page 150)

man enemy, for the sea birds fly to let the birds from the land and then they float into some. Some of these floating objects were dashed towards the water, and before they were taken up by the sea and destroyed by the waves. The sea and their Douglas-built fighters and fighters built under the Doosan Method of manufacture had many, many more of the performance's floating objects and facts.

Even the giant sea waves would break the surface. Not only did they fly off possible in the appointed parts of the earth but these flying and Consolidated built. Flying. Furthermore, and elsewhere proved to have a striking power almost beyond the imagination of some of the errors. The 50th follow-

men called these birds four-engine piston ships, in effect was their striking power.

Such attacks took off for the following: these further and further out upon the banks of these predators. More around the midlands began to rise, in the quiet of the day. "Let's look at the box again." And on the last some made very good looking indeed.

And as more of the midlands moved to the box scores the words of the critics left in their market value, no longer did they and bookshelves may interests of gold, no longer did the journals of the day give space to their company, no longer did people look to the latest books to keep open their minds.

And then finally came a letter from one of the midlands, bearing the entire spread to readers, not to let fact and demand, "And now the bell are those who call our midlands have taken a strike."

Speed Propeller Production

(Continued from page 151)

It was also determined that in order to produce the required volume on one machine it would be necessary to produce three complete patterns for each pin or strike of the machine.

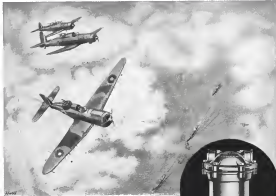
Now the rectangular bar stock is fed through a rough into the machine by a hydraulic feeding device, which eliminates vibration of the bar stock and forms in the feed mechanism.

Instead of milling out the center of the bar stock, three cutting brackets cut in from the side of the bar stock to an accurate tolerance and then three individual planes are drilled at one stroke. The bar then automatically feeds to the next position with special index features ensuring proper alignment.

The second operation is the forming of the three radii on the opposite side of the bar from the side which has been drilled. This is done by means of a special forming bracket. Again the bar feeds to the next position and the pins are drilled.

The third operation is the parting of the bar from the under-chuck which turns drilled and on which the radii have been formed. This is done by means of hydraulic operating on brackets.

When the machine is in operation the bar stock has started to feed, all three operations are performed simultaneously and at each stroke of the machine three complete units are ejected. An analysis made from the operation showed LaPine's machine has been in operation less than the cost per unit for the spruce propeller has been reduced 75 percent.



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To keep the Allen* supply lines open, to enable us to dispose your machines and find where they are wanted, demands utmost efficiency in the field detail.

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Helium Welding

(Continued from page 147)

a magnesium bearing wire, one in Houston, Washington, and British Columbia.

Contrary to popular belief, magnesium alloys are not unfuseable when properly processed, in fact they are more resistant to fuel flames than aluminum alloys. Although magnesium alloys are 35 percent lighter than common steels and 25 percent of the weight of steel per unit volume, their weight strength ratio is comparable to aluminum alloys, and they possess the desirable property of stiffness and rigidity that cannot be obtained in other alloys. With these properties of magnesium alloys in mind, together with the rapid production method of electrodeless and some dynamic advantages which helium welds now presents, the future use of magnesium alloys for the fabrication of structures, especially in aircraft, should be greatly enhanced.

Magnesium castings containing foreign defects have been repaired with this process and welds equal to or stronger than the surrounding metal have been obtained. The weld metal is much more dense than that of the surrounding cast metal and for less resistance to corrosion. Almost any thickness of cast metal that can be poured may be readily welded with this process.

Welding rod of the same alloy as the parent metal is usually used for castings and wrought alloys. The weld metal appears to have better corrosion resistance properties than the parent metal in salt spray tests. The weld metal appears to be suitable to the adjoining metal, which means accurate joining of the original metal adjacent to the weld under severely corrosive conditions.

The tungsten electrode is very slowly alloyed with the weld metal and suitably in a period of time the tungsten electrode must be replaced. No noticeable increase in the corrosion rate of helium welds in magnesium alloys because of the presence of impurities has been noticed.

Helium welds again have been proved as extremely fine grain with particularly fine grain interspersed with the weld metal, indicating that there is a minimum of heating effects on the adjacent metal. This accounts for the very good weld effectiveness obtained on known welded alloys.

Demetral J-311 magnesium alloy, before welded, has approximately 95

percent of the parent metal strength in the weld area. However, at present the design safety factor for welded demetral J-311 is calculated in 75 percent of the strength of the parent metal. These strength values are based on heat treated loads. Weld, lap, edge, or corner welds are weaker than the butt welded joint and must be stressed accordingly.

Helium welding has proven to be a successful medium of attachment for magnesium, stainless steel, brass, monel, nickel, and some of the common steel alloys. Research work is now in progress to extend its use to aluminum and other common steel alloys not immediately known welded. In the helium welding process, a shield of helium gas encloses the molten metal. Because helium gas is an inert gas, it prevents oxidation and eliminates the use of a flux and the danger of entrapped flux in the weld metal that would promote corrosion. The arc is then produced directly between a tungsten electrode and the base metal which takes between two minutes destruction as in the position in vacuum hydrogen welding.

The Northrup helium welding torch is equipped with a helium valve that is opened just prior to the striking of the arc between the tungsten and the parent metal which flows through the torch to the weld. Helium has over 100 times the specific heat of air and when in motion prevents heat accumulation around the weld thereby keeping it cooler and giving a better finish and penetration with less distortion than other welding processes. The arc is struck by a light touching action and quickly draws back from the metal.

Northrup already has developed helium torches which will shortly be available to the industry. The torches are of two sizes to handle 1/16 in. to 3/4 in. diameter and 4 in. to 4 in. diameter respectively and may be supplied with tips of different angles, 45 deg., 90 deg., and 60 deg. The torch may be used for normal welding or, by extending the handle a handle bar ring is obtained for heavier welding. A type of torch will later be available that feeds the filler rod automatically, giving more uniform results than where the weld is fed by hand. Test results are obtained by feeding the filler rod into the tungsten electrode which seals off portions of the rod thereby creating a uniform weld joint. This procedure has been found to be superior to the previous method of feeding the filler rod into the molten pool under

the arc, whereby the molten pool is not sufficiently agitated in level, the cross welds gather on the surface of the pool. Since the molten pool from the tungsten electrode is the filler rod, an angle of 45 to 90 deg. may be maintained between the filler rod and the electrode. The tungsten electrode varies in size from 1/16 in. to 3/4 in., depending upon the thickness of metal welded and the heat required. The torch must be held as near the weld as possible to obtain maximum benefit from the helium for the generation of maximum. Also an arc length of 3/16 in. maximum should be maintained. Poor penetration of welds may result by using too long an arc. On those alloys that have a tendency to be hot short, a rapid welding speed is recommended, approximately 3 in. per min., to eliminate the danger of cracking.

A conventional arc welding machine with direct current generator having a 50 amp output is desirable. However, higher output machines which operate at less than 300 amp may be used providing these ampere may be adjusted. An special machine is preferable in that it is easier to attach a helium tank to such a unit. Reversible amperage and voltage regulators must be provided and the mechanism should have a minimum sequence of 500 ampere of current control. The average life of a 300 m.A. helium tank is about 25 hr. of continuous welding with a minimum-cost tank. Fully paid helium gas is required. Normally helium is purchased from the government plant is sufficiently pure to cause no difficulty. Additional gases in helium such as acetylene, fluoride, hydrogen, nitrogen and the hydrocarbons may cause poisonous effects. Hydrogen produces bad porosity. Oxygen then the metal causing poor resistance and uniformity. The presence of 7 percent nitrogen in the helium reduces the welding speed to about two-thirds that obtained when only 2 percent is present. All of these gases if present, may be removed, however, by passing the helium through filtering mediums.

This method of arc welding has been used in important new and for the

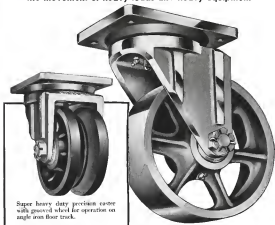


Demetral before welding at magnesium. Welding rod of the same alloy as the parent metal usually is used for castings and wrought alloys. Action, regulated by a finger control valve on the handle of the torch, flow of an electrically isolated gas around the electrode through the torch.

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(Continued from page 104)

Yet, amazingly, the food service is home-like quality. There are three reasons for this. Only the best ingredients are used, formulas employed were originally developed from small quantity recipes; the chefs are absolutely required to follow every formula to the letter.

Members of the whole cafeteria management are located in the organization as a whole in addition to the individual employees. The company doesn't have to worry about the men's problems. Of course, Douglas is credited to all handled by J. L. Stevenson and John Thompson, director and assistant, respectively, of the welfare organization.

It is an organization that handles understanding the activities in the other plants. Douglas is including complete menu feeding plans in all of the new facilities where one portion fits the step.

Of course the question arises as to whether workers are inclined to take full advantage of the food service facilities. Douglas feels that if the food is good, it's automatically acceptable and if the prices are right there's no problem on this score. Other factors being equal, most say employee preference is a lot easier to a good meal.

At one Douglas plant, which is a good living ground where it's been in operation only a few months, about 72 percent of all the workers are eating there each day in the cafeteria and lunch canteen. Of course the men and women figures would run still higher.

Douglas is not to be the only small manufacturing serving breakfast for all shifts. There's great success for this. The new working position hours is the one most likely to neglect his breakfast—he doesn't like to get the milk out of bed and so he's likely to grab a cup of coffee and push off to work. As a result, he doesn't work at top efficiency until after lunch—and maybe not then.

Since breakfast is the only meal being served during the early morning hours, no particular preparation problem is involved there. But there is a trick in having breakfast served for men who come on during the middle of the afternoon or at night. These people aren't concerned to their habits—sometimes they eat at home and again may postpone the cafeteria. To avoid late anti-proportion and to keep from upsetting kitchen mistakes—it's tough to prepare two types of meals for serving at the same time—the Douglas people select items which are suitable for breakfast or dinner—two things like soups and eggs.

The men who have breakfast in the

cafeteria almost invariably eat substantial breakfast—foods such as steaks and eggs and hot cakes and potatoes.

Display Appliances Sells Balanced Menu

When Douglas first began experimenting with food service, the management expected that additional effort would be necessary to sell workers on balanced meals—particularly in view of the fact that a cafeteria setup was going to be used. But extensive food samples has eliminated the need for anything of that type. Salads and vegetables, which many men are inclined to pass up at home are made so attractive that employees buy them of their own accord. A casual check of tables in one cafeteria showed that about 93 percent of those eating lunch at that time had selected distinctly balanced meals.

One thing that contributes to this favorable situation is the care taken to bring out the items in food. In the serving line all foods are attractively plated and, where possible, attractive color contrasts are arranged in the individual dishes. For example, when a white rice is served, there's always a bright vegetable to go with it—best for instance.

Moreover, cooked foods—both those served individually and the ones used in appetizers—are kept whole and are prepared in such a way that they'll retain full natural color. Long pieces of cooked meats and vegetables, for instance, look just like they did before they went into the kettle. Even the bones in soup—Douglas uses whole quarts from which the bones are out of soup—remain whole when they're served.

Then, lighting is placed to emphasize natural food colors. At one of the new cafeterias, red and bright fluorescent tubes are installed so as to highlight both colors and greens—to avoid glare. The panel walls here are set to look at, create a cheerful, restful atmosphere.

At still another scene of stimulating employee appetite, soups are placed far enough ahead that the same customer won't serve more than one in 75 days—approximately not more than once in 22 days. Employees are never given a chance to fire of any one set of foods.

In some way, workers are kept from living off the surroundings in which they eat. Every time a new supply of waitress uniforms is ordered—about once in four months—the designs and colors are changed completely. Even the placement of tables is changed from time to time—another in a practical "The psychology factor is of im-

portance," says Wallace Thornton Bowman. "If you're ever eaten in restaurants constantly, you know that even though the food standard is a given place remained constant, you seem to tire of it after while. That's human nature—we all require some change. Since our people don't alternate from one restaurant to another, we have to provide that needed change—both in food and surroundings—within our own cafeteria."

System and Speed of Service

One of the biggest problems of all, Douglas found, is that of systemizing service so that a maximum number of people can be fed in a minimum amount of time. This problem involves several factors including cafeteria layout, menu arrangement and actual serving routine.

Since one the simplest Douglas plant on many scores, the number of facilities to deal from the cafeteria was an important consideration. If all people had to come in a single, centrally located food service department, many of them would use up a good part of their lunch hours going and coming—and Douglas believes that hurried eating is just as detrimental as improper food or a lack of food.

So, the company has arranged to bring the cafeteria just as close to the work-

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as possible. In some cases that means use of two or more main entrances. In others, bench cafeterias are required. In still others, supplementary service is offered in both portable and stationarycafeterias.

In one of the newest plants, the cafeteria—this one has 16 double serving benches situated in a glass front to right in one side of the main production building. This large, unenclosed plant is almost part of the production process in a single large building; the one large cafeteria here will do the job—for the time being at least.

Another new plant uses two main cafeteria locations, one as a continuous drive-in where the main production level and a second in the administration building.

The main cafeteria plant, and the one which is perhaps best suited to most other plants, is located in one main entrance in a fairly quiet location and then set up smaller serving locations at as many outlying points as are necessary. One of the newer models is one which has been in operation long enough to test its practicability, now. In the past years of this discussion, he considered it a model idea, one main cafeteria where all food is prepared and eight temporary branches do the job. Under general supervision of the unit from above, a section, the H. K. As Service Company, operates the cafeteria for this plant.

The latter are leased by temporary contractors which can be moved at will to fit the current need. There's nothing free about the delivery here—and long tables and benches. But the food is kept—and it's hot. Each branch setup is equipped with a complete portable sink table, refrigerators for ice or cream and other similar products, coffee service and soft drink service. The food is brought to the branches in insulated carts, which are loaded in trucks, delivery trucks. These carts also contain the dishes.

One of the main cafeteria is still used for preparing all food that would be required for feeding 500 percent of the employees when the full force of personnel are needed. Serving capacity here, however, is designed only to meet the needs of workers stationed in nearby buildings. The peak demand is kept within reasonable size by staggering of lunch hours over a 2 hr. period.

In every case, the cafeteria has been arranged to maximize traffic on position—back in the serving line and to the table section. At the new plant mentioned, for example, two serving sections are used, both located along one end of the building. The lines feeding into these service areas flow on two sides of the building. From the serving sections, employees move past counters and on out into a wide counter aisle. From here they may flow out in either of two directions to the table area. Besides speeding up service, this arrangement eliminates extreme lines—and the frustrations which go with them in blockades to food service. In addition, a light-tripped restaurant is used, equipped with lines of humanoids, in that service area continues at any time.

At the end of the cafeteria opposite the serving line is a soda fountain where, in some, as 20 milked coffee can be served at one time. This section speeds both lunch and between-meal service and gives table space for those who eat hot dishes.

The serving line and table arrangement, plus a highly efficient service system, which makes every worker less distant desire to perform, at every moment of the meal period, permit the service of from 30 to 32 people per minute in the most modern.

"Traveling Lunchroom" In Snow Plants

In a few cases, where or when the capital cafeteria and branches could adequately handle the load. Besides the

resulted in portable food carts or foodstalls. These are equipped with built-in refrigerators, hot food storage compartments and coffee units. In one case, eight units operating these trucks sell around \$400 worth of food at the lunch hour. To conserve labor, employees from other departments are used for this job, at a small percentage of the "take" for these lunch hour efforts.

Another variation of the standard set-up in the stationary cafeteria, is self-sustaining food supply system which serves both lunches and specialty foods and beverages to supplement employee lunches brought from home. These departments are usually furnished with a modernized profile and broiler, a large refrigerator and other supplementary equipment. Their specialty is lunch lunches.

With its wider varied food service facilities, Douglas has done everything possible to bring food, but food service must be the workers—in business as in war. The set-up is aimed in the needs of every individual plant.

Goody, Goody Cola and Vitamin

But despite all the emphasis on food service, Douglas hasn't overlooked the original cause of the vitamin deficiency—lack of exercise. The Douglas production record shows that workers before meals. Every plant is equipped with means of convenient hot and cold drink and candy bar machines. And, an employee can take a moment off at any time to purchase these vitamins.

Service all employees are that privilege—but few share it. The Douglas production record shows that workers before meals. Every plant is equipped with means of convenient hot and cold drink and candy bar machines. And, an employee can take a moment off at any time to purchase these vitamins.

The final step in this company's food program has been the sale of packaged vitamins at cost. Bought in large quantities, the price of vitamins is brought down to where every worker can afford them—and the most powerful use of the advantage of this opportunity to build muscle energy and greater health.

Maintaining Arc Welders

(Continued from page 114)

refractory ceramic-lined still cause serious impairment if not complete replacements of these service.

One bad practice, for example, is that of leaving welder protection (eye glasses, gloves, over machine in open line, in such a way as to interfere with the free passage of circulating air into and out of the equipment. These are known, when welders have been equipped with correct eye protection usually installed on and around an open eye, resulting in severe conjunctivitis and (Turn to page 302)

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may sound poetic in a news dispatch, but dust can't do an airplane engine any good. On a score of air fields from the South Pacific to Egypt dust is a problem which ground crews must constantly fight to keep the United Nations air armada flying. We not only have to protect our planes in manufacture against dust but they must be protected on the battle fronts as well. Engine performance records made under actual fighting conditions show that engines not protected by air filters require overhauling and rebuilding after only 30 to 50 hours due to dusty airways. With AAJ engine airplane filters which remove 99% to 99.5% of the dust caused by excessive wear, the overhauling period can be increased from 330 to 430 hours thus saving valuable replacement parts and reducing oil and gasoline consumption.

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AA! AIRPLANE ENGINE FILTERS

(Continued from page 320)

any short-circuiting of life.

Improper connection of extension leads for either the electrode or work terminals is not at all uncommon. This results in a high resistance around from solder to arc and returns with resulting variations in welding current, particularly when the leads are moved or it is changed the resistance of the connection. This is a frequent cause of complaints by welding operators that the heat is not steady. The remedy for this is to make sure that connections are kept tight, and that all connections are made with cables equipped with properly installed cable lugs or terminals.

It is practically impossible to look at a welder without finding a cable to an other electrode and secure a good low resistance joint. Soldered or welded solderless connections at terminals should always be used.

The use of excessively long electrode or work leads will result in excessive tip temperatures leading to embrittlement of the metal where operating in the upper part of the current range unless extraordinarily large cables, or a smaller one twisted in parallel, are used. Overheating of the metal from this cause is a frequent reason for underperformance which impairs off the line with consequent loss of production.

A source of trouble which is not generally apparent to the welder is electrical arcing in the intended or unintended application of long combined steel currents on the ground. This arcing or cable connection resistance can be responsible for substantially short-circuiting a generator for long periods of time. This results in the loss of two heavy generator currents, but because of the low generator voltage involved, does not require sufficient power input from the line to cause the motor involved to trip. While the motor is not damaged, the generator may be only very lightly overloaded or burned out. The same results will follow intentional persistent short-circuiting of the electrode holder on the work or any grounded mechanism.

The use of improperly bonded structural steel systems or building frames for the welding current return circuit is undesirable. The high resistance path thus afforded the welding current may result in overheating of the welder motor, and in addition, there is always the possibility that using an overloading of some poor connection, possibly quite remote from the source of operation, may go unnoticed and start a fire.

No attempt should be made to adjust welding current settings by any means other than those provided and recommended by the manufacturer of the

equipment. Shifting the brushes on overvoltage and back-feeding the brush holder using current will usually result in an increase welding characteristics, increased consumption, and short break life. Short circuiting of resistance elements or any other tampering with the control furnished as an arc welding equipment may result in dangerous or burning out of the equipment.

In tampering welding equipment, rough handling resulting in personnel mechanical damage is all too frequent. Motor-generator sets, mounted on steel wheels, running gear should be moved only at slow speeds—never by means of manual hoists or other vehicles. They should be moved over obstacles and the personnel such as flags (clearance given in traffic), slings and hoists (avoiding of cables to avoid shock to vertically, arranged to avoid damage to cables, handles, and other equipment mounted on the wheels of the set) are used in the same manner as are welder cutters in automobile traffic. Motor machines now on the market are designed to be both shock-proofed and drop-proof. This fact and some basic facts that these vehicles should be used in case or other circumstances without suitable protection.

At the discussion of the use, of course, drop-proof or even open motor generators sets can be operated outdoors (provided they are protected from directly damaging conditions by tarpaulins or temporary shelters. These must be designed so as not to hinder the use of the equipment, as previously discussed.

Thunderstorms

(Continued from page 163)

characteristics noted over the Zenith gas Waterfall Fig. 1, an exceptionally good picture of cumulonimbus clouds south of Alton, Ill. on July 14, 1934, shows such a display of thunderstorms, widespread heavy rainfall due to thunderstorm activity. The rainfall pattern produced by these thunderstorms would be similar to that produced by the groups of thunderstorms described in the first part of this article. The main portion of the clouds which indicate the location of the air shift would constitute the schematic. See pictures shown in Fig. 4.

There are other possible reasons for the rapid dissipation of thunderstorms. The rapidly suggested explanation covering a shearing effect of higher wind velocities still could be defined the cell that the storm would be defined, center on a appreciable amount of rainfall in the forward part of the cloud. The cooling effect of rain falling through this part of the storm would be the

most dissipated in the area of the storm and the establishment of a descending cold column of air in front would not of immediately the supply of storm must end. This would cause the storm to dissipate in rapidly as it moves.

Peterson's has shown that if a transverse movement is superimposed on a convective current the circulation are essentially as shown on Fig. 8. This is also in agreement with circulation shown by Humphreys' on page 353 of his book *Physics of the Air*. If, then, we can assume that the portion of the air in the cloud which follows these streamlines will be very fast most of the raindrops which form, or at least the heavier ones, would be carried to the rear portion of the cloud and would be carried from the forward part of the cloud. The rapid downward of cold air in advance of the main cloud over the heavy rain approximately along the boundary line in the cloud is the same as the growth described it would be coming approximately straight down. Thus, finally, due to the weight of the rain of every cloud would probably be less than the horizontal width of the body of the cloud.

Evaporation from the falling rain contrasts to the rain as it is shown on the rear portion of the thunderstorm cloud as that as the thunderstorm progresses the central portion of the cloud moves backward as indicated by the sketch line on Fig. 4. If the final stage of the cloud could look similar to the schematic observed well ahead with the rear portion relatively flat and the air mass extending well in advance of the main body of the cloud.

The most apparent difference between actual temperatures aloft and the resulting surface temperatures in a thunderstorm, and between the value of observed and computed energy, would suggest that a considerable or even an "enormous" amount of energy may be supplied to a thunderstorm through evaporational cooling due to the falling rain.

The virtual simulation in a thunderstorm as suggested by Humphreys and Peterson seems to be substantiated by the agreement in wet bulb temperatures aloft and that at the surface (see figures as well as his observational and theoretical explanations).

One of the most useful descriptions of the nature of a thunderstorm and one which defines some of the questions made is that suggested by Shaw:

"The following interesting account by Prof. John W. of one of his colleagues explains it as follows as strong convection produces."

"According to commonness, I started on Kalmuk but on an early first aerial



A few of the 21 types of AAJ filters are being used to protect Marine planes.

warriors from the Center Square of Cephiss, at precisely fifteen minutes past two o'clock in the afternoon, it being the 17th of June, 1944. A shield before me, the wind whirled on a short distance in the direction I intended, after which the storm became nearly perpendicular until the height attained was about twenty-five hundred feet, when the hailstorm moved off toward the east with a velocity much greater than that of its onset. When I had reached a point about two miles east of the town, there appeared a little distance beyond and above me a low black cloud, being that the horizontal velocity of the hailstorm would carry it westward and beyond the cloud, perpendicular waves of rain made to effect it by throwing out some hailfall as soon as it hindered should be needed. Hailstorming was now difficult in case, and the hailstorm moved directly for it. I was hesitating, with the fog of hailfall in my head, whether I should throw it out for the hailstorm, or continue straight on as I was then going to the place just now toward. By this time I had reached a fog underneath the cloud, which was exposed and immediately fell an aperture in the machinery, and precisely an upward tendency of the hailstorm, which also commenced to rotate rapidly on its vertical axis. I might have disengaged gas and probably have passed underneath it; but thinking that it would soon be penetrated, and then might be passed above, as it appeared not to be moving when I could not hesitate in letting the hailstorm go on its own way. The cloud, to the best of my judgment, moved on ones of from five to ten miles in diameter, it appeared a circular form as I entered it, considerably depressed in its lower surface, presenting a great concavity toward the earth, with its lower edge very rapid and falling downward with an agitated motion, and it was of a dark smoke color. Just before entering the cloud, I noticed, at some distance off, a storm-cloud from which there was apparently a heavy rain descending. The first sensation I experienced when entering this cloud were extremely intense. The cold had now become violent, and everything around me of a thirteenth nature became thereby covered with hoarfrost, my whiskers yiffing out with it far beyond my face, and the rods running from from an oval building the glass rods, then being placed with ice, and once and had now miserably getting all around me. The cloud, at this point, which I perceived to be about the width of it from the terrible storm going on, had now that I could appreciate I observed on entering it, but was of a light, silver color, and so dense just at this time that I could hardly see the hailstorm, which was extreme

first above the sea. From the intensity of the cold in this cloud I supposed that the gas would rapidly condense, and the hailstorm consequently descend and take me out of it. In this, however, I was doomed to disappointment, for I soon found myself whirling upward with a fearful rapidity, the hailstorm gyrating and the air descending a large circle in the cloud. A great resemblance the rushing of a thousand soldiers, commingled with a general marching sound of wind, commingled on in the terrible fight. Whether this noise was seen caused by the hail and rain which were so furiously pelting the hailstorm I was unable to tell, as the monstrous sound must certainly have had under noise, I was in hope, when being hurled rapidly upward, that I should escape from the top of the cloud; but as in downcast expectations of an opposite result from the terrible noise, deep-penetrated me upon an ice, and the hailstorm, suddenly descending, which had already been interrupted by its final glancing through the top of the cloud, now vanished, with a violent downward surge of the hailstorm, as it appeared to me, of some hundred feet. The hailstorm melted, only to be hurled upward again, when, having attained its maximum, it would again sink down with a vomiting and fearful relativity, to be hurled upon again and left. This happened eight or ten times, all the time the storm rising with unabated fury, while the damage of hailstorm could not be out of the top of the cloud, nor the discharge of gas out of the bottom of it, though I had expanded at least thirty pounds of the former in the first attempt, and not less than a thousand cubic feet of the latter, for the hailstorm had also become perforated with holes in the center that were formed where the hailstorm ran as the smoke at the top, which then descended from the hailstorm, and would in the swirling and swirling motion pass it through.

"The density of the cloud did not appear able all through it, as I could at times see the hailstorm distinctly

short sea, also, occasionally, pieces of paper and whole newspapers, of which a considerable quantity were blown out of my net. I also noticed a violent oscillatory motion or waves of the top of the cloud going on, and a pronounced undulating of the hail and snow, as though it were projected from every point of the compass."

Flight Considerations

Several comments and suggestions are offered for pilots when they find it necessary to fly through a thunderstorm area or upon it. In approaching a line or group of thunderstorms it is always safest to approach the situation and decide on the course to be pursued before attempting to fly through them. The greatest vertical velocities and most severe turbulence are usually found in the upper two-thirds of a thunderstorm cloud. Severe turbulence and a constant swirling and rolling motion are usually present in the lower forward portion of the cloud. The roll which forms in the part of the cloud gives some indication as to its direction when it is absolutely necessary,不得已 directly into a thunderstorm cloud. If there is no choice it is usually safer to avoid the central lower forward portion and fly in or along the edge or just below the base of the cloud providing the altitude of the base is 2,500 ft. above the ground. The vertical velocities in the portion of the thunderstorm above the base but below the turbulence and the danger from an upward to downward current or vice versa are sufficient to cause an airplane to rise or fall abruptly for a considerable distance. The pilot should be highly conscious to enable the pilot to regain control of these conditions as encountered.

In flying through a thunderstorm there is always the danger of coming into severe roll. It is at all possible it is best to fly below the clouds and around the area of heavy rainfall. If it is necessary to fly above the base of the clouds in an area where there are general thunderstorms, it is usually safe to fly between the thunderstorm clouds; but one should be prepared to encounter varying degrees of turbulence. In general it can be stated that the wider the clear spaces the less the turbulence and the narrower the clear spaces the greater the turbulence.

Flying through a thunderstorm in a southeasterly region is very hazardous at all times since a sudden drop of a few thousand feet could cause serious loss of altitude. It is best to fly between or over the thunderstorms.

The same general suggestions apply to dorsal thunderstorms except that, (Turn to page 255)

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ing, the usual felt cover is applied to the plate die, and the die is ready for production.

The material most of the plate containing 10 percent of nickel steel has a sheet 364 per in. While this is more expensive than plate of pure iron or steel, the labor costs for dies, per finished part, are usually less than with any other material, and production is not interrupted or delayed through the lack of the material used.

Subcontracting Policy

(Continued from page 158)

new equipment, what will you need in the way of help to meet this schedule?" As William F. Quinn, assistant general manager of Pratt & Whitney told Airman, such a program was set up because it was felt that the engine company could best expand by having the subcontracting experts at the main plant.

The increased expansion represented a continuation of the corporation's long-standing policy of utilizing subcontracting. Pratt & Whitney—the largest division—has, in fact, turned work out since its very inception.

Many of United's subcontractors have grown tremendously—here, for example, started work on a one-man shop—both as volume of work being done and the number of parts being produced. Nevertheless, the new changed with maintaining the subcontracting program still have plenty to do especially in the follow-up work necessary to maintain the quality which is absolutely essential to aircraft engine production and delivery of quantities as set to hold up final assembly of engines, propellers and airplanes.

Multiplicity of this work is done by the purchasing departments which, when necessary, call in the engineering or engineering or production departments to help one out make that division to the right output. The very informality of the organization of the corporation as subcontractors grow it increased flexibility which has proved of inestimable value.

All preliminary educational work which every subcontractor seems to require, is done in the corporation's own plant. After investigation by the division have indicated a potential subcontracting plant can handle a job, its key men are brought into the "parent" plant for training—for several months if not every. United also gives the subcontractor every possible aid in securing the proper type of equipment so that adaptation of other machine tools will be obtained entirely or kept to the lowest possible minimum.

Another P & W practice is to purchase all new materials and make the necessary inspections before delivery to

the subcontractor takes place. The division also places inspectors in some subcontracting plants as a means of saving time, material and transportation. These inspectors often serve as "standards" authorities, helping the subcontractor to produce work which will pass Army and Navy inspection.

The matter of rigid inspection often proves the greatest trouble to subcontractors and many times it is caused only by the tough rule of "throwing rejects right back in their laps" until the work comes up to par. The value of meeting an equally rigid Pratt & Whitney standard and both over-see-long years have proved by superior and untiring performance of American engine construction on fronts all over the world.

While growing business to Ford, Buick, Chevrolet, Nash-Kelvinator, Jacobs and Continental has used Pratt & Whitney's work for subcontractors, new organizations are still being added to the list. This is due primarily to the fact that engineering progress brings changes which call for new types of work in new materials. The increased power being developed by today's engines, for example, requires stronger bearings which, in some cases, call for new alloys. Thus, a hardware manufacturer which for years had been working with material alloys recently sent by him to United to go over time and processes to determine what could be done to produce at least part of the requirements.

While the search for subcontractors has never ceased, there is every indication it will be continued far, as Mr. Quinn points out, "This country, probably more than any other, has been one of specialists, it has a knowledge that can't be found in any other country in the world. Therefore it is only logical to profit by this expertise which makes it possible to control and keep on expanding."

With this state of affairs subcontracting has been followed by the Hamilton Standard Division, reviewed by Van Allen John H. Towner with producing "roughly three quarters of the properties required for motor planes and advanced trainers in our own way efficient and, in addition, a majority of the properties required for British planes."

In addition to meeting just as close tolerances as other branches of the industry, propellers as well as engine parts additional problems in their lot also become an outstanding factor.

It is impracticable for those without proper machines and skilled operators to attempt to manufacture precision parts in the quantities required day after day. It is not a question of making one part in the proper circumstances—it is a question of turning out thousands in the same exact measurements

and making prompt deliveries to the main plant so that production schedules may be met without any delay.

The majority of these working subcontracting works are not equipped with expensive machines adapted to work of this kind, particularly internal and external grinder and thread millers and thread graders, while still others fail to realize the close tolerances required.

Constantly such cases—each all involve time and money—is estimated by United officials that only about one in every hundred potential subcontractors is ultimately created a contractor. "Proved" means, of course, as that they comply each work in the close tolerances necessary. No other shape, it has been found, lack one or two machines essential to complete a part, and proposed acceptance of orders will not produce the required quality.

Lack of skilled labor—or labor of any kind—is also a serious obstacle in some small shops. However, for example, a potential subcontractor called on Vought-Sikorsky seeking several available jobs.

"How many men do you employ?" he was asked.

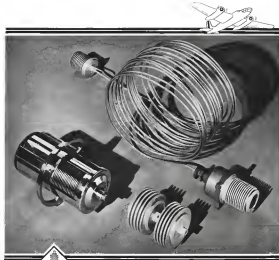
"Oh, none now, but I have a lot of friends in plants around here I'd like out and put to work."

After that would have meant making the make of dies, plans and tooling custom already working, and there was no way of telling when, if ever, he would have been able to get tools or a building in which to house them, he didn't get a subcontract.

In another case when Vought-Sikorsky needed shorter work into a plant to see why the night shift had made practically no deliveries for three weeks they found the breakdown at a simple milling machine operation. A few questions brought forth the information that the operator—up to three weeks ago—had been engaged in an unrelated line of work.

Despite the fact that only about one in a hundred potential subcontractors actually get work, Vought-Sikorsky—as well as other United divisions—subcontracting is still on the increase. It has reached the point where complete new plants are being built outside the plant by an automobile body company, with other subcontractors moving in from widely scattered parts of the country.

United has found—to have many other prime contractors—first subcontracting by subcontractors has not always proved satisfactory, the division of responsibility in such has made it impossible to maintain production schedules which will deliver the quality necessary for motor planes, engines and propellers. In our own case, when the subcontractor had been asked (Continued on page 159)



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AVIATION FUELS • AEROSHELL OILS

(Continued from page 236)

by an outside agency, the work was so precise that Lippert and its original sub-contractor, who had been doing inter-laboratory work since the corporation's inception, both had to take over the operation to maintain a production balance.

And despite the constantly increasing limitations, there is every indication that subcontracting on a major scale will not only continue through the wartime schedule, but will figure as an integral part of postwar plans and production. As one official pointed out, "It worked well before the war, it's working now, it should work after the war."

For general and maintenance future planning by potential subcontractors, however, one point is brought out which will help both the producer and those who would take on part of his work: it is in the advantage of both parties for the mass working a firm-out job to list all existing tools and gauges, particularly add new or special equipment. In many cases, such tools may require minor adjustments, but with the producer's knowledge and knowledge of his requirements, they can be made to do a job which otherwise would go unmade.

Piston Rings

(Continued from page 237)

this operation would destroy the shoe fit and its advantages. If any major cylinder reconditioning is necessary, the service department of the cylinder manufacturer should be contacted for detailed recommendations.

Pistons and Piston Rings

Before new rings are fitted, pistons should be thoroughly cleaned and all carbon removed from the piston ring grooves, and the oil drain holes in the oil ring grooves should be cleaned out. Care should be taken to prevent damage to the grooves during this cleaning operation. With the piston rings under disassembly, the compression rings are wedge or vee shape and the engine manufacturer furnishes these rings in groove widths of .0005 in., .0010 in., and .0020 in. Under normal conditions appreciable greater wear does not take place, and if this is the case, new rings can be installed in the grooves after cleaning, provided they fall within the limits for side clearance shown in Fig. 13. In some cases, where the grooves are not severely worn, it is possible to use the .0005 in. groove rings in them without refinishing, providing the proper side clearance is maintained. It is the trend that the grooves are worn enough to require reworking, it is unwise to cut the grooves narrower to fit the new rings.

Under no circumstances should the pistons be given the same degree of fit as they would normally wear the piston and ring lands. Care should be taken to preserve the order in the bottom of the scraper, the oil-ring scraper, a piston speed and is supplied by the engine manufacturer, together with a gage, in order to maintain the proper angle as necessary for proper fit. When pistons are removed to overcome wear, the service should be in accordance with the manufacturer's recommendations such as 6.000 in., .0010 in., and .0020 in. Intermediate crankshaft rings are not furnished, and engine rings should not be ground down to intermediate widths. Special grinding machines are required for this precision operation to prevent damaging the balance of the rings.

Compression rings should be replaced at each overhaul. The dual oil control rings and the skirt may be effectively cleaned and used again if they show no signs of wear or loss of tension. They may be determined by means of micrometers and loss of tension is indicated by reduction of free gap in the ring. It is advisable to check with a spring scale each as shown in Fig. 12 to determine the exact tension of each ring.

Any or all clearance of the rings also were to show the amount of wall wear (indication of radial thickness) of each the gap between .0005 in. for each .001 in. wear on the diameter. The gap opening is checked as shown in Fig. 13 by means of feeler, and both end and mid rings should be checked by this method before reassembly. Be holding a size of this type up to the light, a rough indication of the fit of the ring in the cylinder is indicated. In all cases, rings should be fitted in the end gap clearance shown in Fig. 10, and this clearance may be adjusted by carefully filing the ends of the ring and leaving the sharp edges with coarse cloth. If no ring gaps such as shown in Fig. 13 is available, and clearance may be checked by placing the ring in the barrel and of the cylinder barrel up against the end of a spare piston to insure that the ring is normal to the cylinder surface.

The piston ring arrangement for the engine under inspection is normally shown in Fig. 10, but may be varied somewhat if special rings of cylinder materials such as nitralloy steel are used.

Lapping Piston Rings in Cylinders

In most cases, to insure quick seating of rings and cylinders, it is recommended that the rings be lapped in the cylinder barrel in which they are to be installed. This operation will also remove the "oil plane" from cylinders which have been in service and improve the

sealing of rings and cylinders. The piston rings are normally assembled with a narrow, and dressed finish on the oil, and lapping should be carried out until these two surfaces are removed and the surface appearance indicates the complete contact between the rings over the entire width of the ring. The number of strokes required to produce such a surface is dependent upon several variables, including the ring material, the lapping compound, length of stroke, etc. A mixture of two parts kerosene in one part of Class 2-A lapping compound has been used with good results. It is recommended that a 1600 to 1800 grit paper for the lapping operation to give a better grade to the rings during the lapping operation. It must always be remembered that the rings are not to be lapped to a short length equivalent to that of a conventional piston. The piston or lapping plug should fit snugly on the cylinder to ensure proper alignment for lapping. The lapping operation should be carried out in the ring rod, thus ensuring that the rings are seated and held in the oil. Dual rings which are to be re-used should also be lapped as otherwise the polished surface will not readily make a new seal against the cylinder.

After the lapping, rings and cylinders should be thoroughly washed in kerosene, and any further steps on the rings should be removed with a fine stone or smooth cloth, after being taken out to form a radius on the ends of the ring. Any rings which show an irregular surface pattern on the periphery should be discarded as this is an indication that the ring has been bent or distorted.

When installing the rings on the piston, care should be taken to prevent square twisting or distortion. After the rings have been installed, the side clearance of each ring should be checked, and for the engine under disassembly, these limits are shown in Fig. 13. When checking the side clearance of wedge type rings, the outer face of the piston rings should be held flush with the surface of the piston, and the side clearance measured between the top of the piston ring and the piston groove. This clearance should be checked at several points around the periphery. This piston will be normally, before installation into the cylinder, should be dipped in regular engine oil and the rings compressed with a ring clamp to prevent damage during installation. The bearing of the bearing of this article, these "fits and pieces" are vital to satisfactory engine performance, and they require careful handling throughout all of the fitting and assembly operations to retain the precision originally built into them by the piston ring manufacturer.

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Plywood Structures

(Continued from page 137)

Any suggestion that plans as equipped exclusive plywood wood aircraft involved a major revolution of design, development and substantial retooling of the shops. While the more advanced companies have gone so far as to construct and/or design groups competent to handle wood structures, real attention was not given to wood aircraft until the metal shortages became severely restrictive. It is now apparent that a substantial number of the aircraft required under the present program will be so constructed, and the current scramble for design information is the result.

The construction of wood airplanes is infinitely simpler than in a corresponding metal airplane. The wood is much easier to assemble into a clean, smooth article (Fig. 6), and the number of wood craftsmen available and competent far exceeds the metal trades. Additionally, it should be recognized that the principal plants using wood and wood craftsmen during previous years have fallen within the line of war production. This drawing, also ready availability both the machine and the men needed for wood aircraft.

Drop Hammer Operators

(Continued from page 131)

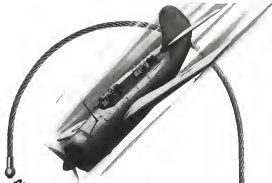
From a finished and correct part, iron lines are placed on the two sides of the preformed iron template. The template is then inserted along these lines and may now be used to make all parts.

Although it is the opinion of many people that the use of drop hammers brings with it excessive scrap, this impression is erroneous and is due to the fact that the excess material is trimmed off at the parts after drawing so that it is visible to the casual observer. In other methods of manufacturing, such as with most dies in a punch press, this material is trimmed prior to forming. Actually only a portion area from any sheet of material can be utilized for formation of parts and the remaining portion becomes scrap.

Navy Alters

Air Technician Requirements

The Navy has altered its additional requirements for qualified aviation technicians to permit such men to enlist and continue their course of instruction. Aviation mechanics, machinists, and electric men and radio men, between the ages of 17 and 26 will be granted deferment from active duty up to three months to complete course.



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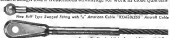
That is because American Cable *Korodless* controls have wires and strands of internal stress. Therefore, cable and strand is easier to handle, quicker to install, and resists bending longer.

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IN war or in peace, you and your fellow Americans require 1,455 lbs. (raw weight) of food every year. Soldiers require even more.

In all, for ourselves and our allies, America must produce, process and transport 250 billion pounds of food per year, for the duration, and for many years thereafter.

► Don't try to remember that figure, but do remember that food processing is a huge industry, is a high state of technical development, but not yet fully understood into the war effort.

The food industry needs overall coordination, comparable to longestablished coordination. America needs an administrator of food supply, to move products in equipment and transportation and to end confusing and overlapping committee jurisdictions.

If the food supply gets into a tangle, through lack of a comprehensive plan, the result will make the rubber shortage seem a picnic in comparison.

► In the expanding production, the Food Production Engineer will be strictly in the middle. He is neither a general nor a field strategist, but a production man who understands what the government is all in about on production, equipment production and distribution.

The Food Production Engineer must see that the food is grown in proper quantities, at proper distances from the plant, and delivered in perfect condition. . . . From that point on, he has all the problems of ordinary management, but he has all the problems of ordinary management, plus the job of contributing to the nation's food supply of color, aroma, taste, texture and nutritive value which nature intended only for a few broad leaves of vegetation.

Reprints of this advertisement are available in handy booklet form.

McGraw-Hill Publishing Company, Inc.

330 WEST 42ND STREET

NEW YORK

That was tough to do, even in the days of unlimited refrigeration and freezing. But under the urge of saving cargo space for men and machines, new attitudes have been worked.

Fortunately for us, in the evolution battle between bulk and low cubic content, the latter is winning.

Food Production Engineers—by developing machines and processes for freezing and compressing—have reduced whole sides of beef to a carton the size of a new knee.

► They have replaced bulky refrigerator ships by using the holds of ordinary cargo vessels with boxes of frozen beef. Preserved by dry ice, these "dry boxes" pack frozen beef in perfect condition—while the beef itself goes to allied countries for making TNT.

Eggs, stripped of their shells, travel through a dehydrated array of processing machines, leaving space-making water vapor in America, but sending every ounce of energy-rich food value to war far-flung areas and allies.

When the Food Production gets through with a basket of ripe tomatoes, you can hold the standard replacement package in the palm of your hand . . . and only replaceable water has been lost.

► The work these men are doing will easily be the equivalent of freezing a ship a day, in the processes which have been perfected are applied to more and more food plants.

If, under the constant pressure of fire, sea, and drought our shortages, you find yourself sitting down to meals of dehydrated meats, fruits and vegetables, you can thank the Food Production Engineer for the fact that the source food supply will be ripe—red and delicious in taste. That soup was full-flavored and nourishing. That asparagus has been lost but the water you have replaced.

This advertisement appeared in a group of newspapers on Tuesday, October 23, 1942

How do you get the cube root of a cow?

READ the newspaper advertisement, captioned as above, and you'll see we are telling the public (and government) about the job engineers are doing in stuffing bigger food production into fewer ships.

When you get to that part of the ad that tells about Food Engineers reducing a cow's carcass to the size of a couple of suit boxes, you will have reached the point where McGraw-Hill really lives.

In Food Production, too, it's our job to collect the "how-to-do-it" news on each new advance in technology and equipment, and pass on this information to an entire industry.

The Industrial Press of America implements the exchange of ideas, which is a national characteristic and one of the secrets of our industrial development.

Through the interchange of ideas, made possible by the Industrial Press, the men of American technical genius is greater than the sum of its parts.

If a food engineer in Illinois learns how to add and control Vitamin A in a food product, all food manufacturers learn how it was done, through a magazine like **FOOD INDUSTRIES**.

If a manufacturer develops a new dehydrating machine, production men learn what it will do and how it operates, through the informative and helpful advertising that is characteristic of the Industrial Press.

No matter what your industry or your job, you can probably remember many instances where an industrial magazine has helped you find a solution to a production problem.

But valuable as they are, Industrial Magazines cost only a few dollars per year.

That's why the route slip is so puzzling. If a man needs to see a magazine at all, he should not be under pressure to pass it along.

For help in studying the proper distribution of technical magazines among the men in your organization, write to the Reading Counselor, c/o McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York.

THE McGRAW-HILL NETWORK

25 publications, which gather "war-news" from the "war-production-front" through a staff of 153 editors and 735 engineers-correspondents . . . More than 1,000,000 executives, designers, production men and distributors use the editorial and advertising pages of these magazines to exchange ideas on war-production problems.

THE McGRAW-HILL BOOKS

Publishers of technical, engineering and business books for colleges, schools, and for business and industrial use.

McGraw-Hill Publishing Company, Inc.
330 WEST 42ND STREET • NEW YORK

THE McGRAW-HILL NETWORK OF INDUSTRIAL PUBLICATIONS

Automotive Machinery

Aviation

Rail Transportation

Business Week

Chemical Metallurgical

Engineering

Coal Age

Construction Methods

Electrical Contracting

Electrical Merchandising

Electrical West

Electrical World

Electronics

Engineering & Mining Journal

E. & M. I. Metallurgical Minerals

Engineering News-Record

Factory Management & Maintenance

*FOOD INDUSTRIES (Illustrations/Maps)

ago, Petroleum, Radio, Television and Appliance

Mill Supplies

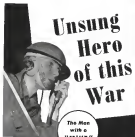
Power

Product Engineering

Tentile Work

Transit Journal

Wholesale's Salesman



The Man
with a
"MIKE"

Photo by U.S. Army Signal Corps

Vital Link in the Victory Chain— Sensitive, Rugged Microphones

He seldom gets a hero's welcome, but the man with a mike gives a mighty important part in modern war. Along with the pilot, bombardier, gunner, and crew with more sophisticated tools, he is in the thick of every fight. His chief weapon is a small, rugged, extremely dependable microphone—a vital link in his supply of communications equipment.

Kellogg Microphones meet the high performance standards required for military use—stand heat, snow, grow, grow resistance to climate changes, shock and hard usage, sensitive transmission of voice frequencies, etc., etc.

Kellogg lavens prime or sub-contractors of the U. S. Government to provide their company's products not only for microphones, but also for the many other types of communications equipment for military use which they do year after year in equipped to manufacture to specifications.

KELLOGG SWITCHBOARD & SUPPLY CO.
444 N. GLENN AVENUE, ELIZABETH, NEW JERSEY



A few examples of Kellogg products for military use. Some of the numerous types of portable equipment which Kellogg makes is shown in this illustration. They include portable and fixed microphone, amplifier and radio sets, power, receiver, transmitter, amplifier and receiver, and many other items directly related to military and civilian communications.

KELLOGG

WHERE ENGINEERING AND RESEARCH BUILD

Finer Communication Equipment

FOR WAR AND PEACE



The name "IRVIN" on the harness means the chute is produced in at Irvin Factory with over 20 years of experience and skill in chute-making.

Literature can be had by school or training executives for the making. Address Main Office, Buffalo, N. Y.

IRVING AIR CHUTE CO., INC.
1670 Jefferson Ave., Buffalo, N. Y.

Other factories in United States, Canada and England

IRVIN

Air Chutes

SERVING OVER 40 GOVERNMENT AIR FORCES



A NEW HIGH IN FINISHING SPEED



Brightboy Ward, finishing solution, is the only one that is not a liquid and does not burn or stain.

For a complete list of products, contact Brightboy Sales Office.

"The Soft Rubber Roller Coats The Abrasive"

FINISHING speed-ups, frequently combining a number of operations, are being achieved by BRIGHTBOY.

Brightboy breaks the job between a grind and a buff. Because an abrasive is rubber enclosed, it produces a finish at substantial savings in operation and labor. Works on all metals—steel, brass, aluminum, steel, copper, brass.

Brightboy wheels can be buff, polish and put on a slight curve in use operation. Brightboy blocks and special shapes have numerous applications for manual and drill work, especially for close-tolerance jobs.

Available to new customers through recognized mail supply dealers. Brightboy Sales man at your service. Write today for catalogs and prices of your dealer cannot supply you.

BRIGHTBOY INDUSTRIAL DIVISION
Weldon Roberts Brightboy Co., Newark, N. J., U.S.A.



1. Removes light dirt, rust and heat marks.
2. Cleans polished and polished metal.
3. Polishes steel.
4. De-burrs light chamfers and rounded parts.

aircraft instruments . . .

- how to use them
- how to test them
- how to repair them
- how to install them

All who are in any way concerned with aircraft instruments will find that the one complete, practical manual on the subject. The book describes in detail all types of aircraft instruments—engine, navigation and flight—and makes plain the fundamentals of their construction and operation. It gives further complete methods for installation, use, testing, trouble finding and repair.

AIRCRAFT INSTRUMENTS

By George B. Davis
325 pages, 545 illustrations. \$5.00

THE full and explicit treatment presented in this book is in accordance with the "general requirements" concerning instruments and related procedures for all operations current, and includes copyrighted information from these sources as well as working charts, formulas, tables, trouble-finding lists, etc., not elsewhere available in a single book.

Answers your questions on—

- operational instruments
- engine gauges
- navigation
- flight instruments
- altitude and speed
- fuel gauges
- engine indicators
- compass
- radio
- directional gyro
- altitude indicator
- time-of-day indicator
- etc., etc.

MAIL THIS COUPON

McGraw-Hill
ON-APPROVAL COUPON

McGraw-Hill, 1221 Avenue of the Americas, New York, N. Y.
Send me my copy of *Aircraft Instruments*, by George B. Davis, at \$5.00. I will pay for it in 12 equal payments of \$0.42 each, plus 5% per month on the unpaid balance. I will pay for it in 12 equal payments of \$0.42 each, plus 5% per month on the unpaid balance. I will pay for it in 12 equal payments of \$0.42 each, plus 5% per month on the unpaid balance.

Name _____
Address _____
City and State _____
Postoffice _____
Company _____
I enclose with this order \$1.00. I will pay the balance of \$4.00 in 12 equal payments of \$0.42 each, plus 5% per month on the unpaid balance.



WRIGHT Improved High Speed HOISTS ARE FAMOUS FOR THEIR ABILITY TO STAND ABUSE—HELP THEM TO TAKE IT NOW—PROTECT THEM

The No. 1 precaution is: Don't Forget the Grease Guard! A hoist *won't* wear needs thorough lubrication once a month. Keep your load chain well lubricated, too.

Wright's No. 2 precaution is: Don't Overload Your Hoist. Watch both the top and bottom hook of it to doubt about the condition of workmen. Weight hoists are drop forged from special steel which, when overloaded, give visible warning by slowly sagging. Wright load chains are also high in elastic limit. Don't continue to use hoists or chains that have stretched.

Take proper care of your *WRIGHT* hoist so that it lasts. Where properly lubricated and maintained, many *WRIGHT* hoists have given continuous, trouble-free service for 20 to 35 years. You can find the name of your nearest Wright distributor in the telephone book.



WRIGHT MANUFACTURING DIVISION
Yak, Pa., Chicago, San Francisco, New York
In Business for Your Safety

AMERICAN CHAIN & CABLE COMPANY, Inc.
NEW YORK - CHICAGO - SAN FRANCISCO

KAPOK FELT CONTRIBUTES TO THE EFFICIENCY OF CONSOLIDATED B-24s



A roll of Kapok Felt is fed into the machine which is used for the application of the Consolidated B-24 in the final stage of the manufacturing process. A Kapok felt manufacturing machine will soon ship.

The value of Kapok Felt (K-Felt) is beyond question as it gives an air seal to the fuselage. Therefore, the "K" Felt interlayer, in B-24 bombers and others, serves to maintain internal pressure while also protecting the crew comfort by deadening and absorbing noise, without adding weight, cost, time or space.

The properties of "K" Felt are unaffected by severe temperature changes, vibration, or shock, which explains the widespread use of this material in almost all types of defense instruments and across their numerous operations under severe flying conditions.

Manufactured in specially and "pure" K-Felt is the highest modulus known, it does not "give" in weight, and is non-compressed and non-permeable. It meets all the points of the important Air Corps specification No. 44086, Types I and II. Our stocks of available Kapok Felt are ample, and we are equipped to make immediate prompt deliveries.

Write Sheet No. 1, "K" Felt will be sent on request, or an experienced Sales Engineer will call at your place.

American Felt Company

TRADE MARK

General Office:  GENEVA, CHAM.

Products: America's Oldest Manufacturer of Aircraft Felt. Used by the U.S. Navy, U.S. Army, U.S. Marine Corps, U.S. Coast Guard, U.S. Air Force, U.S. Navy, U.S. Army, U.S. Marine Corps, U.S. Coast Guard, U.S. Air Force, U.S. Navy, U.S. Army, U.S. Marine Corps, U.S. Coast Guard, U.S. Air Force.

TASK FORCES

and



TASK METALS

Just as a task force is sent out to accomplish a definite war operation, so is Ampco Metal selected to do a definite application job.

Wear parts are subject to highly stressed conditions—where a bearing is needed that can "take it" under a severe operation—where good bearing characteristics and long life are imperative—Ampco Metal does full duty and holds its rank.

Physical properties of Ampco Metal are highlighted in the table below. To meet outside government specifications, modifications of standard grades are available to conform to specific chemical requirements.

These Victory Grades are subject to the standard Ampco laboratory control that extends from raw material through to the finished product.

AMPCO GRADE	PHYSICAL PROPERTIES OF AMPCO METAL			
	TENSILE STRENGTH	YIELD STRENGTH	ELONG.	HARD- NESS
10	47,700 PSI	31,200 PSI	22.0%	100-105
15	47,700 PSI	31,200 PSI	22.0%	100-105
20	47,700 PSI	31,200 PSI	22.0%	100-105
25	47,700 PSI	31,200 PSI	22.0%	100-105
30	47,700 PSI	31,200 PSI	22.0%	100-105
35	47,700 PSI	31,200 PSI	22.0%	100-105
40	47,700 PSI	31,200 PSI	22.0%	100-105
45	47,700 PSI	31,200 PSI	22.0%	100-105
50	47,700 PSI	31,200 PSI	22.0%	100-105
55	47,700 PSI	31,200 PSI	22.0%	100-105
60	47,700 PSI	31,200 PSI	22.0%	100-105
65	47,700 PSI	31,200 PSI	22.0%	100-105
70	47,700 PSI	31,200 PSI	22.0%	100-105
75	47,700 PSI	31,200 PSI	22.0%	100-105
80	47,700 PSI	31,200 PSI	22.0%	100-105
85	47,700 PSI	31,200 PSI	22.0%	100-105
90	47,700 PSI	31,200 PSI	22.0%	100-105
95	47,700 PSI	31,200 PSI	22.0%	100-105
100	47,700 PSI	31,200 PSI	22.0%	100-105

Consult with Ampco engineers. Ask for data sheet "Ampco Metals as an Abrasive Specimens."

AMPCO METAL, INC.

Department A-11 Milwaukee, Wisconsin



50 years of EXPERIENCE for you to use

HIGH quality electrical control devices are not made merely by putting men, tools and materials to work. Long familiarity with electrical control problems is needed to develop dependability, long life and precise performance. That is why Automatic Electric's half century of experience is so important today in designing and producing all our products.

This same experience is reflected throughout Automatic's new 80-page catalog. It contains more authoritative data, about a wider variety of electrical control products, than you will find in any other book on the subject. Be sure to write for your copy.

And Automatic Electric's field engineers can provide practical maintenance tips—make valuable time-saving and efficiency-saving suggestions. Ask our nearest representative to work with you in selecting the equipment best adapted to your needs. A letter or call to our nearest office will bring full information promptly, or if you prefer, write us direct.

AMERICAN AUTOMATIC ELECTRIC SALES COMPANY
1033 West Van Buren Street, Chicago, Ill.

RELAYS

and other control devices by
AUTOMATIC ELECTRIC

Now you
can measure



MAGNETIC DRAIN PLUGS now provide an easy way accurately to check internal engine wear. Under normal conditions an insignificant amount of metal abrasive is produced by the contact of moving parts. But when any part undergoes excessive fatigue, the breakdown of metal increases rapidly. The use of Magnetic Drain Plugs in place of ordinary drain plugs not only makes it possible to observe the amount

of metal that is dropping caused by wear, but when an unusual amount is noticed, it is often possible to locate the trouble through an examination of the metal particles picked up by the magnet.

Aircraft engine manufacturers and engineers are invited to write for a free catalog giving applications and construction data, etc.



Lisle Corporation
BOX 1022, CLARKSBURG, IOWA

**Magnetic
DRAIN PLUGS**



Help these **NEW** men
with *easier-reading*
BW prints



SKILLED engineers are working under pressure to plan new machines—new parts. Yet those who must create these plans in the shop are often semi-dull and unskilled employees to whom old-fashioned blue prints are confusing. Help these new men to avoid errors and delay with Bruning Black and White (Black line) Prints. The sharp black lines on white backgrounds are far easier to read—the white backgrounds make checking simple. No wonder so many plants prefer BW prints for shop use!

Remember, your Bruning BW prints are produced faster than blue prints... need no washing or drying... can be made instantly in large quantities on sheets cut to the exact size of your tracings. Get the facts about Bruning BW—a free booklet is yours for the asking. Charles Bruning Company, Inc.

100-100

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Washburn-Rose's Ins. photo



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for *Every* Aircraft
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Whether your requirements may be, there's an Onsrud router to do your job faster, easier, and more accurately. Write for the facts on any type of router you need or describe the kind of work you must do.

Router manufacturers of aircraft machine tools, Onsrud offers a line of routers where design is based on an extensive knowledge of aircraft operations and where construction principles have been proved sound by millions of machine hours of operation. Write for booklets on any Onsrud router: 1. radial arm, pedestal type, or portable.



The versatile Onsrud "alter" router for shop and portable use.

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The Onsrud Onsrud "alter" router for shop and portable use.

Onsrud
Air Turbine and High Cycle
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**ROUTING • DRILLING • SHAPING
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There is an unlimited demand for
**ROOSEVELT
TRAINED MECHANICS**
to help



That is why **ROOSEVELT AVIATION SCHOOL** is emphasizing its highly specialized

**MASTER AIRPLANE
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as essential Career Training which fits the graduate to meet every requirement for Civilian Employment as a Maintenance Mechanic on Army Airplanes and on Commercial Airplanes.

If it averages forty mechanics to keep one airplane in the air, it will take 1,000,000 mechanics to keep 50,000 planes in the air.

No other type of expert is so badly needed as the Master Airplane and Engine Mechanic.

If you want a training that will put you to work and keep you at work—now and after the war—sign and mail the coupon below and do it now.

We can accept only thirty students per month.

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SIGN AND MAIL THIS COUPON AND DO IT NOW!

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Gentlemen: Without obligating me, please send the facts regarding your highly specialized
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THE SERVICE LIFE
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PROVED BY THE
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Non-crystallizing fuse element

The Littelfuse fuse element is composed of an alloy of copper, bismuth, lead, and antimony. It is non-crystallizing and remains in a molten state of fusion when the fuse element is subjected to the stresses of fusion. (Littelfuse is not a trademark.)

AIRCRAFT ANTI-VIBRATION TYPE

LITTELFUSES



Exclusive Littelfuse Design

1) Lowest resistance
2) Lowest voltage drop
3) Lowest temperature rise

Send for Complete Littelfuse Catalog
For descriptive and applications of these
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Littelfuse Avenue, Chicago, Illinois.

LITTELFUSE INC.

1000 BAKENWOOD AVE. CHICAGO, ILL.

ON LAND and in the AIR

MILITARY PYROTECHNICS

For years we have specialized in the development and production of Pyrotechnic and Signal Equipment for military and marine use.

This broad experience makes us one of the few manufacturers of quality and dependability required in the many different types of military pyrotechnics we are today supplying the United States and Allied Governments.

Due to expanded facilities, however, we are able to take care of our commercial customers providing prompt delivery as applicable.

INTERNATIONAL FLARE-SIGNAL DIV.
of THE ALLCOCK MFG. CO., Tipp City, Ohio

Dillon DENSITE TESTER

**PORTABLE
10,000 POUNDS
CAPACITY!**

Measures 25 pounds lighter 16 inches and
weighs 100 lbs. Test range from 10 to 10,000
pounds. Large machine, open for wide
range of use. Economically designed, easy
to operate. 100 lb. net weight.

Write for Catalogs & R.

W. E. DILLON & CO., INC.

**PARABOLICALLY
FOCUSING
SOUNDWAVE**

with Sterling Portable
Soundloc Sander

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ECONOMY

ECONOMY GRINDING OIL has revolutionized thread grinding practice. Throughout the aircraft industry all highly stressed threads are ground in precision thread grinders for accuracy and fine finish with Economy No. 1554, helping to speed production.

Economy Grinding Oil permits your wheel to grind a true and accurate form.

When a large amount of metal is removed, ECONOMY GRINDING OIL allows the grinding of a thread in two passes, one rough, one finishing, and the surface of the ground thread possesses accuracy of form with the surface structure undisturbed.

New catalog E-17 well worth having. Yours for the asking.

BREWSTER & BAGLEY COMPANY
Detroit WOODBURY, MASS. Minneapolis

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**Sorry!
IT'S NOT FOR SALE**

JUSTRITE Safety HEADLIGHT LANTERN

Uncle Samuel saw it first... and he's taking all of the new Justrite Safety Headlight Lanterns we can make.

It's really a lamp. Can be used either as a head lantern or clipped to the belt. Shipped with "bullet" bulb socket—able to use standard bayonet type and special. Adaptable for focused beam or flood light. Heavy gauge metal battery case, black enamel finish. Same bulb in lot.

Oh... this new lantern is not for sale... except for military use. But it is an example of one of the many new Justrite developments which will be available after this war.

Ask your jobber about other Justrite Safety Products or write direct.

JUSTRITE MANUFACTURING CO.
3742 Southport Avenue, Chicago, Illinois

JUSTRITE Safety Products

SAFETY CANS • FILING CANS • OIL WASTE CANS
APPROVED SAFETY ELECTRIC LANTERNS

EXPERIMENTAL WORK OF EXTREME PRECISION

Machining and assembling of experimental aircraft engine parts for the future high-power engine requires precision workmanship of the highest order. The same high degree of skill which has led aircraft engine builders to construct this work to us is available to others who are faced with problems of a similar nature.

• Write Us Concerning Your Requirements

THE GOVRO-NELSON COMPANY

1931 Antoinette Detroit, Mich.

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GRADUATE IN 17 MONTHS
Qualify for Aeronautical Engineering as follows: Graduates of this school are eligible for employment in various branches of the aeronautical industry. They may also be employed in the design, construction, maintenance, and repair of aircraft. Graduates of this school are also eligible for employment in the design, construction, maintenance, and repair of aircraft. Graduates of this school are also eligible for employment in the design, construction, maintenance, and repair of aircraft.

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1000 E. Washington St., Indianapolis, Ind.

Many **CIVILIAN** Jobs
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Instrument Technicians

Here's where YOU
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Army Aircraft Maintenance Experts
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These men form the backbone of the Army's aircraft maintenance program. They are responsible for the maintenance and repair of all Army aircraft. They are also responsible for the maintenance and repair of all Army aircraft.

Compare to U. S. Army Air Corps
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1000 E. Washington St., Indianapolis, Ind.

Our graduates are employed in various branches of the aeronautical industry. They may also be employed in the design, construction, maintenance, and repair of aircraft. Graduates of this school are also eligible for employment in the design, construction, maintenance, and repair of aircraft.

Be An AIRCRAFT INSTRUMENT TECHNICIAN

YOUR COUNTRY NEEDS YOU NOW
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AFTER THE WAR YOU WILL BE A LEADER IN THE NEW, UNDISCOVERED FIELD
Aircraft Instrumentation is essential to the operation of all aircraft. The instrument technician is responsible for the maintenance and repair of all aircraft instruments. He is also responsible for the maintenance and repair of all aircraft instruments.

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If you are interested in this field, contact us today. We will send you a free brochure and a list of our graduates.

NEW YORK SCHOOL OF AVIATION INSTRUMENTS
1000 BROADWAY 10th Fl. New York City, Dept. 1, Circle 4-2018

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formerly LUSCOMBE
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WILLIAMS
DROP-FORGINGS
ANY SHAPE-ANY MATERIAL
COMPLETE FACILITIES
"Large Ahead With Forgings"
J. H. WILLIAMS & CO.
The Drop-Forging People
117 W. 42nd St. New York 36, N. Y.

Sail THROUGH ANY STORM WITH GROB
HIGH GRADE
STEEL FILES AND
DIE MAKING MACHINERY
THE SOULMATES BEST FRIEND
Get this in stock, today! Men
of science, men of art, and men
of the sea—GROB is the best—GROB is
the only machine that can make
any size of steel file or die.
GROB BROTHERS
INCORPORATED, NEW YORK 17, N. Y.

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PREFERRED
AS A SOURCE OF
WASHERS
Literature on Request
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If there is anything you want—
or something you don't want that other readers
of this paper can supply—or use—advertise in
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AVIATION "CLASSIFIED"

For C.A.P. and C.P.T.P.
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